Electronic technology

principal contents

Ferrite Cores as Logical Elements

Optimal Lumped Loading

P-N-P-N Switch Applications

Rectifier Modulators

FIVE SHILLINGS

DECEMBER 1961 VOLUME 38 NUMBER 12

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MAINTENANCE	813	813	CV26	30	100
	8298	8298	CV2666	200	20+20
	832A	832A	CV788	200	7.5+7.5

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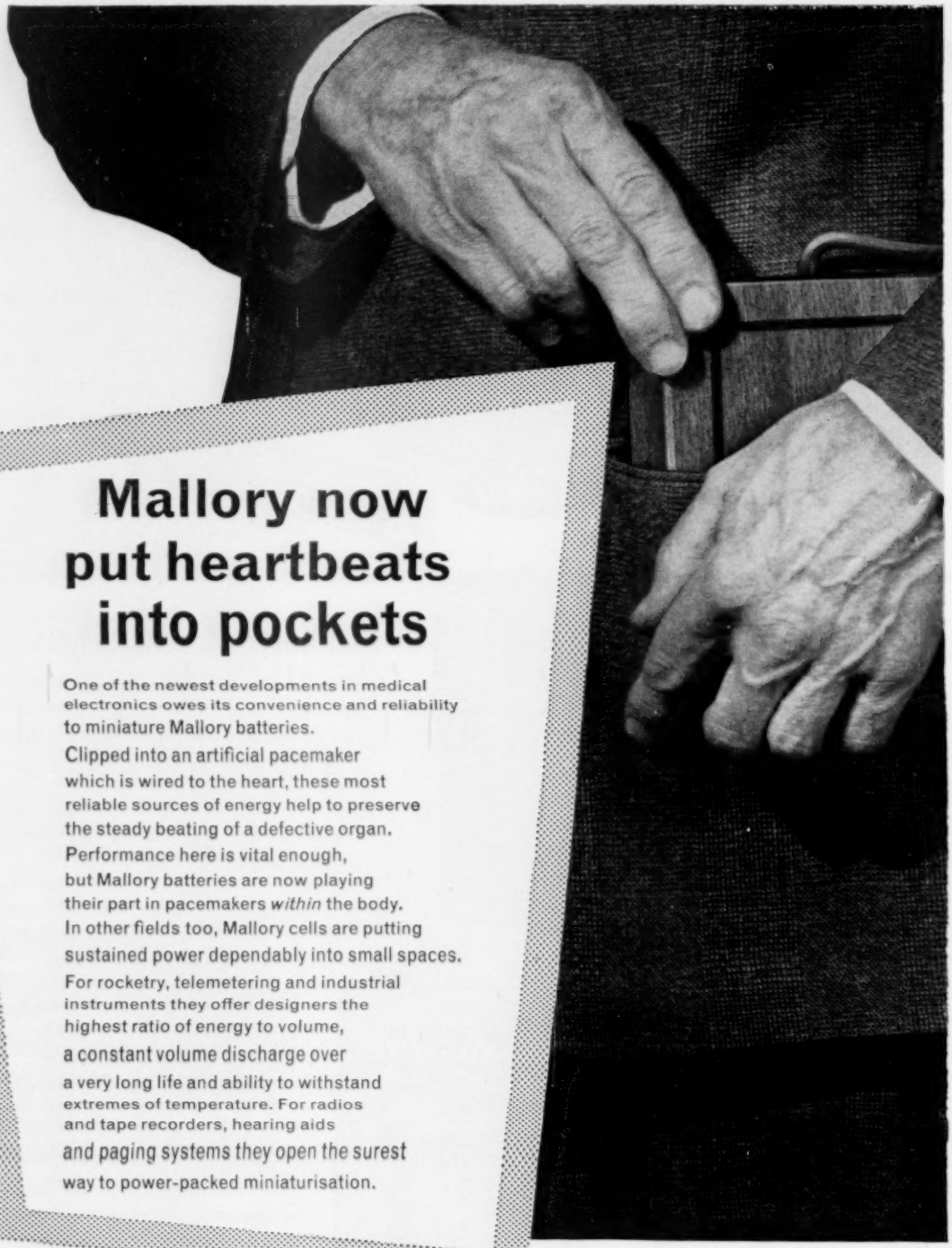

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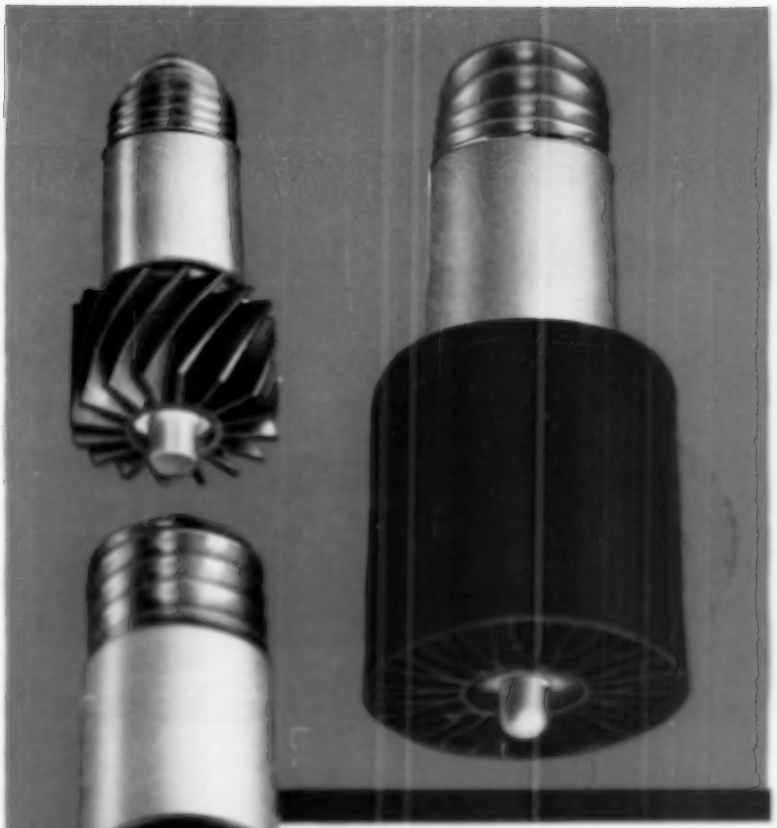

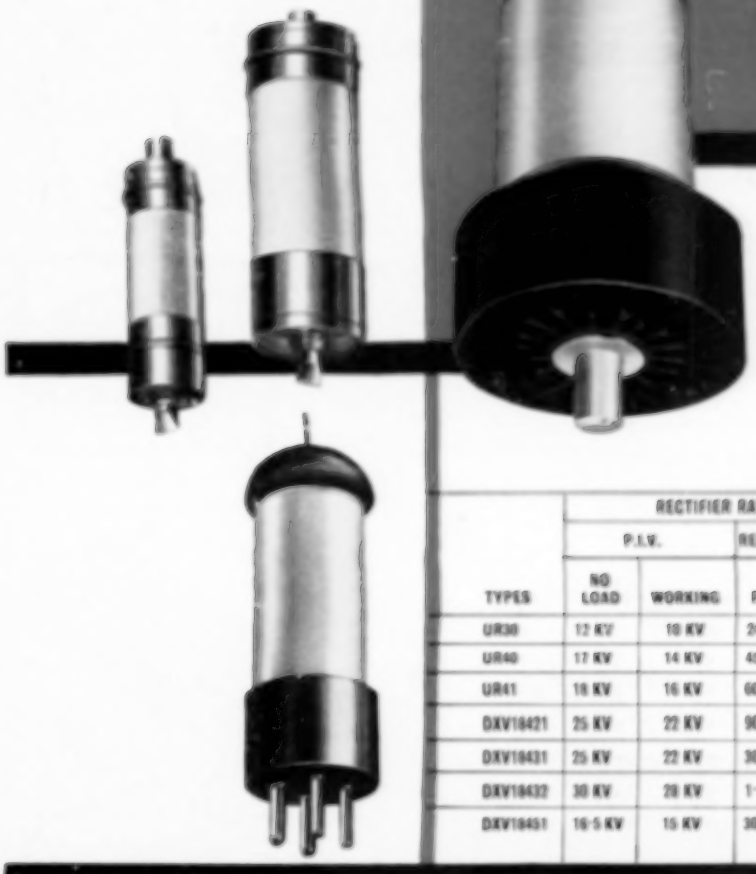

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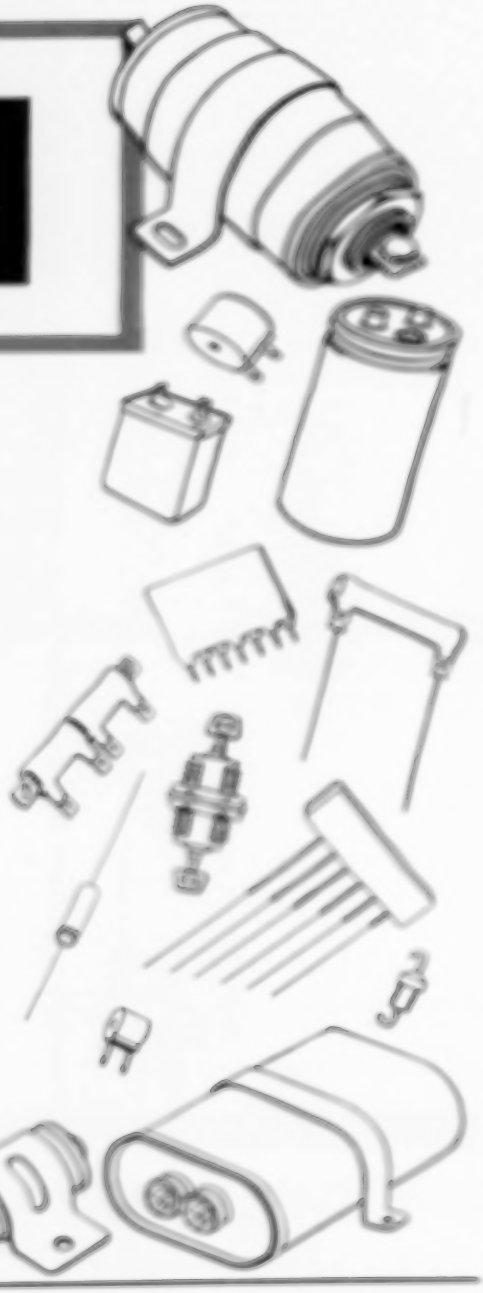

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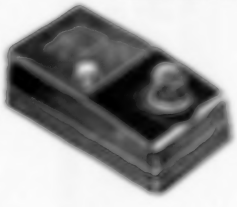

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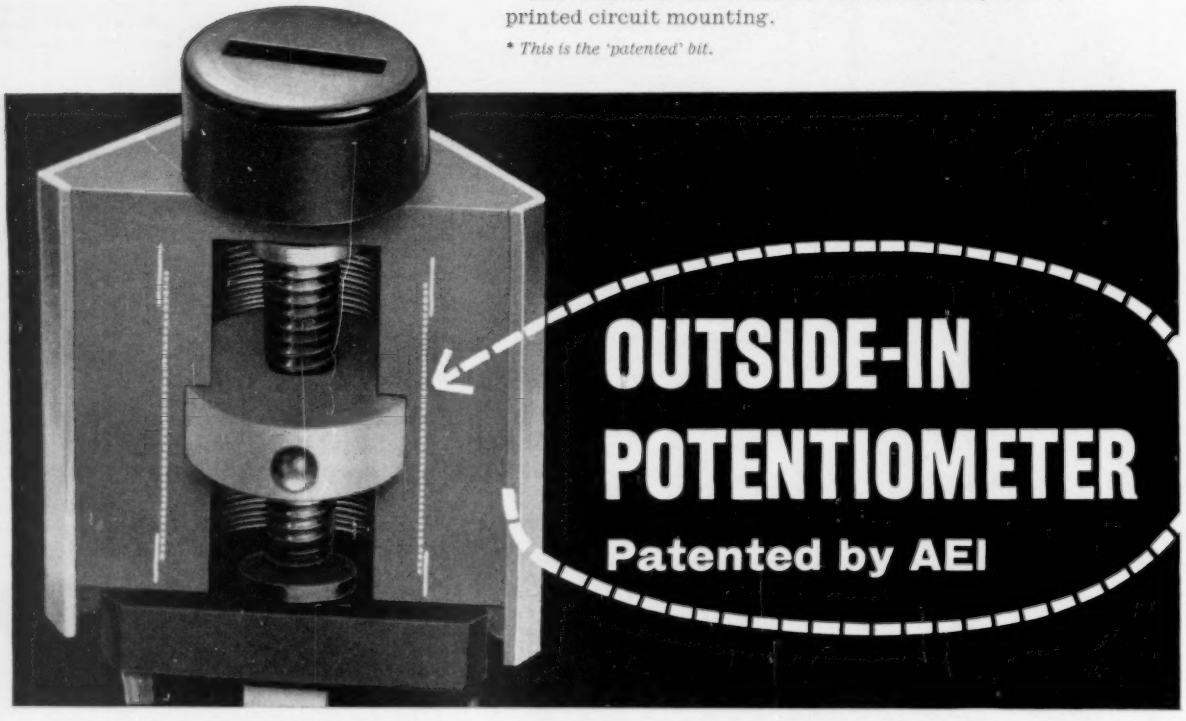

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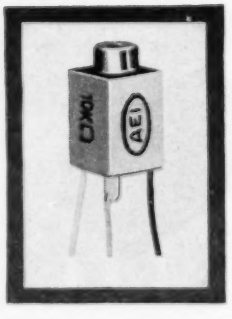

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Communication

WE recently came across a sentence which struck us because it expressed so clearly what we have long believed. It was "To extend the scope . . . would mean foregoing that prodigality of words which distinguishes teaching from (the) skilled précis writing. . . ." So says Professor Emrys Williams in his Preface to "Thermionic Valve Circuits" (Pitman, 4th Ed.).

So many people now urge brevity in writing that it is refreshing indeed to find someone with other views. The urge started because of the post-war paper shortage; it has continued because a theory has grown up that it saves time. It is said that there is now no time to read long articles.

The theory is, however, based upon the assumption that every would-be reader has at his finger-tips all the background information necessary to a comprehension of the new idea which it is the purpose of the article to convey. In fact, few readers do have this information. Anyone who puts the theory into practice, therefore, runs the risk of making himself incomprehensible to all but a few.

The purpose of a technical article, however, is to impart information to as many people as possible and a well-written article does this so that the reader can comprehend the matter easily and quickly. Misunderstandings are avoided by expressing an idea in more than one way; that is, redundancy should be included to reduce errors in communication. Sufficient background information should be included to enable those who are not specialists in the subject to grasp at least the essentials of the matter without having to look elsewhere.

We regard this as essential to efficient communication, and it cannot be achieved without a certain "prodigality of words" which lies between the extremes of unnecessary verbosity and the near précis. Both extremes are time wasting, on the one side because there are too many words to read, on the other because the average reader has to refer to other material if he is to understand.

The proper number of words in any case calls for a nice judgment, of course, but it is better to write too many than too few. It is easier for the reader to skip what he does not need than to supply what is omitted. It is also easier for editors and referees to recommend cuts than to ask an author to expand.

It will appear that we regard the writing of a technical article as an activity akin to teaching. That is so, for in both cases the requirement is to convey information to people who do not already know it.

Ferrite Cores as Logical Elements

IN DIGITAL COMPUTERS

By B. R. Wilkins*, B.Sc.(Eng.)

SUMMARY. *The properties of ferrite cores are explained, and some of the ways in which they can be arranged to provide logical functions are then described. The operation of a typical core logical circuit is then analysed, and the implications of the analysis in design are discussed.*

Logical circuits usually employ valves, diodes or transistors as their principal components. In computer stores, however, it is common to use ferrite cores, which, as will be explained, are bistable devices with advantages in some respects over valve or transistor bistable circuits.

The interesting possibility arises of extending the use of ferrite cores to logical circuits. We will examine briefly the ways in which this can be done, but before doing so we must take a look at the properties of the cores themselves.

Properties of Ferrite Cores

The usefulness of ferrite cores in digital computers stems from the fact that the B–H loop for this material is approximately rectangular.

An ideal rectangular B–H loop is shown in Fig. 1. If a core with this loop is subjected to a field sufficient to drive it to saturation, then when the field is removed, the remanent condition of the core will be either P or Q, depending on the direction of the applied field. Further applications of the field will cause no change of flux, but the application of a field in the opposite direction will cause a change of flux proportional to $2B_r$ and will also cause the core to take up the other remanent condition. Thus the core is able to store one binary digit, with the P state representing 0 and the Q state representing 1. It should be observed that with this ideal form of B–H loop there is no change of flux density unless the applied field H is numerically greater than the coercivity H_c. Thus the core may be sensed by applying a field of $-H_{max}$ to it: the change of flux density is $2B_r$ from a core containing 1 and zero from a core containing 0.

* Department of Electrical Engineering, University College London.

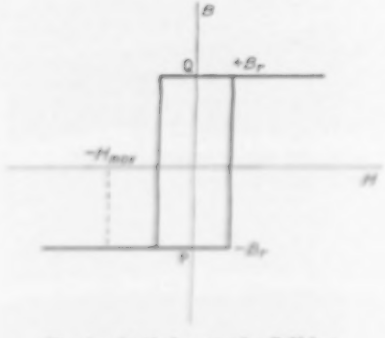

Fig. 1. An ideal rectangular B-H loop

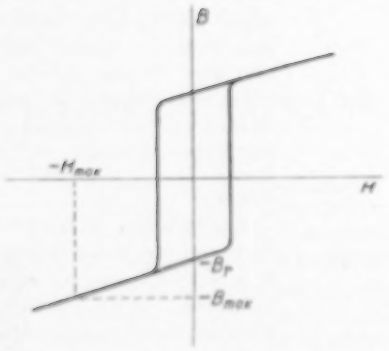

Fig. 2. A practical rectangular B-H loop

Fig. 2 shows the form of B–H loop obtained in practice. The principal departure from the ideal is that B_r, the remanent flux density, is not equal to B_{max}, the flux density corresponding to the applied field H_{max}.

Thus, while the change of flux density in a core containing 1 is still approximately $2B_r$, that from a core containing 0 now has a finite value $B_{max} - B_r$.

When a core is sensed, the resultant change of flux is detected by means of a pick-up winding on the core in which an e.m.f. is induced. Thus the design of later stages must be such that the induced voltage due to $2B_r$ is effective while that due to $B_{max} - B_r$ is not.

A typical core used in computers has the shape and dimensions shown in Fig. 3. Although these cores are very small, a still smaller size is being used commercially, having outside diameter 0·05 in., internal diameter 0·03 in. and thickness 0·015 in.

Magnetic Core Systems of Logic

Magnetic core systems of logic depend ultimately on the transfer of binary digits from one core to another, logical operations being performed during the transfer period. The differences between the various systems lie primarily in the method by which this transfer is achieved.

Two Core per Bit System

In the two core per bit system, as its name implies, two cores are used for each 'bit' (or binary digit) of information. The basic operation of this system may be explained by reference to Fig. 4.

The X and Y windings supply driving pulses which alternate in time, and which set the cores to '0'. Now suppose that C_1 contains a '1' and C_2 contains a '0' at a time when a driving pulse is applied to the X winding.

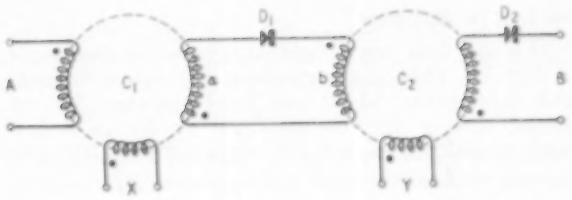

Fig. 4. *A basic two-cores-per-bit logical circuit*

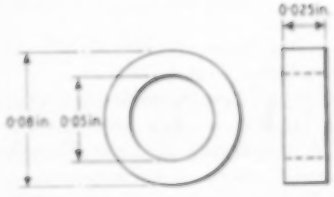

Fig. 3. *The shape and dimensions of a typical ferrite core*

The change in flux produces an output voltage across the a winding, such that current flows through the low-resistance path of D_1 into the b winding of C_2. This current is in the direction which sets C_2 to '1'. If a driving pulse is now applied to the Y winding, C_2 is set to '0', and voltages appear across the b and B windings. The voltage across the b winding cannot produce a current sufficient to reset C_1 to '1' because although it encounters the low-resistance direction of D_1, the a/b turns ratio is made greater than one (six is a typical value). Thus it is arranged that although the output from the a winding is sufficient to switch C_2, the output from the b winding is not sufficient to switch C_1. The diodes D are necessary because when C_1 is switched originally by an input at A a voltage is induced across winding a, which is in the direction to switch C_2 to '1'. However, it is in the high-resistance direction of D_2, and so the switching is confined to one core. Similarly D_2 prevents a signal being produced at B when C_2 is switched by C_1.

It will be seen that in this circuit, information which is inserted at A appears at B after one cycle of shift pulses. We may note here that digits can be passed along a long chain of such cores without being lost, because the actual shifting operation is performed by the driving pulses and not by the signals themselves.

One way in which this system is built up into logical circuits is shown in Fig. 5, which shows an 'OR' circuit. The similarity to the circuit in Fig. 4 may be clearly seen.

Fig. 6 shows a 'NOT' circuit. We may note that any function which is being used as an input to an 'AND' circuit may be effectively turned into a 'NOT' input by simply reversing the connection to the appropriate winding on the second core, without the necessity for a 'NOT' circuit. This system clearly admits of representation of any logical function. It has a disadvantage in requiring two sets of shift pulses, but this limitation is not severe.

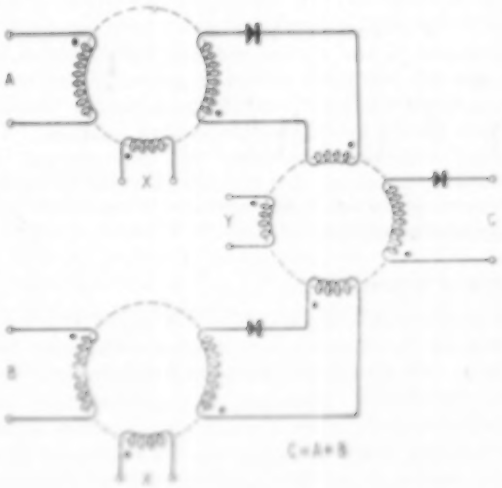

Fig. 5. *A two-cores-per-bit 'OR' circuit*

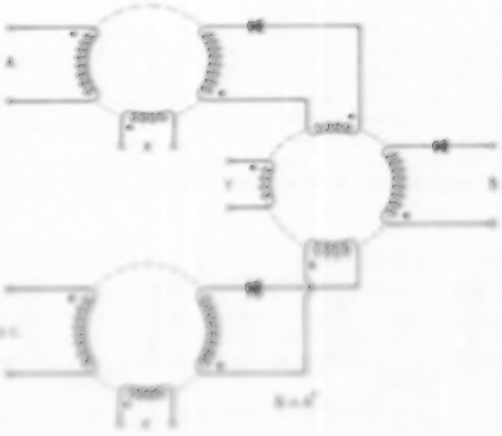

Fig. 6. *A two-cores-per-bit 'NOT' circuit*

One Core per Bit System

The 'one core per bit' system is based on the circuit in Fig. 7. This circuit employs only one shift pulse, and the function which had been performed by the second core in the 'two core per bit' system is now performed by the capacitor C. Suppose that both cores contain '0' and a signal is then applied at A, setting C_1 to '1'. A shift pulse is then applied to X, switching C_1 back to '0', and causing a voltage to be induced across a. This is in the low-resistance direction of D, but current is prevented from flowing into the winding b by the limiting resistor *R*, and so it flows into the capacitor and charges it. After the signal has passed, the capacitor then discharges through *R* into the b winding of C_2, switching C_2 to '1'. The capacitor cannot discharge back through the a winding because of the reverse resistance of D. As in the case of the two core per bit system, the A winding has fewer turns than the a winding to reduce the possibility of a '1' being transferred in the wrong direction.

Fig. 8 shows an 'OR' circuit in this system. Comparison with Fig. 5 shows that apart from the coupling components (*C* and *R*) and the shift pulse connections, the two are identical. This is generally true: any 'two core per bit' circuit can be made into a 'one core per bit' circuit by making these same changes. The essential differences between the two systems are summed up by saying that the 'one core per bit' system uses more components but operates in one shift pulse period instead of two.

Commercial Systems

It is not within the scope of this paper to try and explain all the magnetic core systems which have been devised: full accounts of many such systems have been given elsewhere[1]. However, two systems have been described recently, both of which are of interest because the 'building brick' principle has been followed to the limit; that is to say the logical circuits are completely standard 'black boxes' with sets of input and output terminals, the particular logical operation performed being then determined solely by the external connections.

The first, described by D. Eldridge[2] employs the basic circuit shown in Fig. 9.

The drive pulse applied to winding S tends to switch the core to its '1' state, and the drive pulse applied to winding R tends to switch the core to its '0' state. These pulses are called the set and reset pulses, and follow each other in time without overlap. If a positive voltage is applied to the input, the transistor is cut off and the winding C is effectively open circuited. Under these conditions the core will be continuously switched

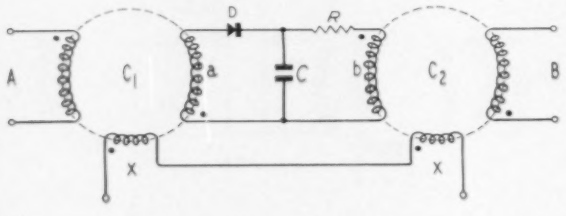

Fig. 7. *A basic one-core-per-bit logical circuit*

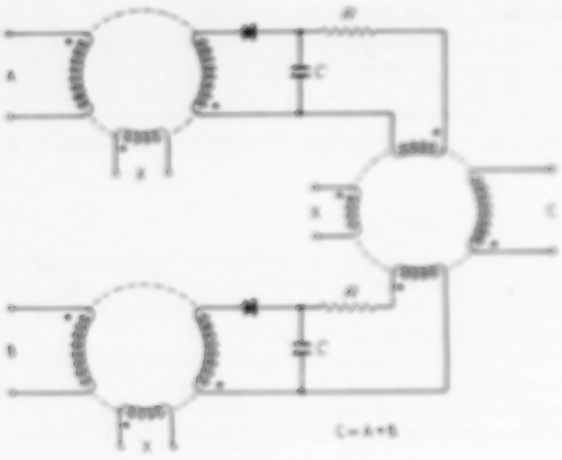

Fig. 8. *A one-core-per-bit 'OR' circuit*

by the set and reset pulses, thus causing signals to appear at the output windings.

In the absence of an input, the transistor bottoms, thus acting as a short circuit, so that the ends of winding C are effectively connected directly through diode D. This holds point P nearly at earth potential, and prevents change of flux in the core, so preventing the core from being set to '1'. Thus the output is controlled by the input pulse, although the input pulse is not itself responsible for switching the core.

A second system described by A. F. Newell[3] is based on the circuit shown in Fig. 10.

The operation of this circuit is similar to that of the two core per bit circuit shown in Fig. 4. The main difference lies in the use of a transistor between cores. This takes the place of the diode in the previous circuit in preventing a pulse from being passed to more than one core at a time. It also means that the current used to switch C_2 is no longer provided by C_1 but by the collector voltage supply V_c. The output from C_1 is used only to determine whether the transistor should be cut-off or bottomed.

The basic logical unit in this system is shown in Fig 11, which differs from the circuit of Fig. 10 in that three input windings are provided and also a winding for a set or reset pulse. In practice the same unit is used for all logical functions, even though not all of the windings are always needed.

Both these two systems have been designed using the cores illustrated in Fig. 3.

Analysis of Shift Register

It was said at the beginning of the last section that magnetic core systems of logic depend ultimately on the process of transferring binary digits from one core to another. For this reason, the basic circuit of a system of core logic is often taken to be that of a shift register. Three of the systems discussed have in fact been introduced by way of the shift register circuit: Figs. 4, 7 and 10 show shift registers in the one core per bit, two core per bit and Newell systems respectively.

Shift registers may be used as delay lines, timing circuits or series-parallel or parallel-series converters, so that besides being the basis of the logical circuits they are of importance in their own rights.

It is possible by trial and error to make a circuit that will fulfil the function required, and to judge from the scarcity of published analysis of magnetic core circuits, it is an empirical approach based on experience which is employed in industry. However, this arrangement is amenable to analysis, even if only approximate, and this analysis could form the basis of the economical design of all kinds of core circuits.

Theory of Ferrite Cores

The behaviour of the cores may be analysed on the bases of standard theory and the published data for the cores.

Consider a core which is switched from one state to the other.

Then if the peak induced e.m.f. per turn of pick up winding is $(e)_{max}$ we have

$$(e)_{max} \propto \left(\frac{d\Phi}{dt}\right)_{max} \quad .. \quad .. \quad .. \quad .. \quad (1)$$

where $d\Phi/dt$ is the rate of change of flux.

Also the total change of flux is nearly constant for all values of H greater than H_c.

$$\text{Thus } \left(\frac{d\Phi}{dt}\right)_{max} \propto \frac{1}{t_s} \text{ approximately} \quad .. \quad .. \quad (2)$$

where t_s is the switchover time.

It is also found experimentally that the switchover time depends on the applied field, such that

$$t_s \propto \frac{1}{H - H_c} \quad .. \quad .. \quad .. \quad .. \quad .. \quad (3)$$

Thus, from Equs (1), (2) and (3), we have

$$(e)_{max} \propto H - H_c$$

and so for the complete winding

$$E = aN(H - H_c) \quad .. \quad .. \quad .. \quad .. \quad (4)$$

where E is the peak e.m.f. appearing across the complete winding

N is the number of turns on the winding

H is the applied field

H_c is the coercivity

a is a constant.

Fig. 12 shows the output obtained from an FX 1,508 core with a single-turn pick-up winding when the applied field is $H = 1{\cdot}7\ H_c$. Also, from the published data for the cores, $H_c = 1{\cdot}65$ oersted $= 1{\cdot}65 \times 10^3/4\pi$ $= 83{\cdot}6$ A/metre. Thus, from Equ. (4), we have $85 \times 10^{-8} = a \times 1 \times 0{\cdot}7 \times 83{\cdot}6$ so that

$$a = 1{\cdot}45 \times 10^{-8} \text{ ohm-metre}$$

A further relationship which will be required is that connecting the field applied to the core with the ampere turns.

For a toroid, $H = NI/\pi d$, where d is the mean of the inner and outer diameters of the toroid. Thus, in our case, $d = 1{\cdot}65$ mm, and

$$H = \frac{NI}{\pi \times 1{\cdot}65 \times 10^{-3}} = 193\ NI$$

$$\text{or } H = kNI \quad .. \quad .. \quad .. \quad .. \quad .. \quad (5)$$

where $k = 193$ metre^{-1}.

Finally, we have

$$t_s \propto \frac{1}{H - H_c} \text{ or } t_s = \frac{c}{H - H_c} \quad .. \quad .. \quad .. \quad (6)$$

where c is a constant.

From Fig. 12, we see that when $H = 1{\cdot}7 \times 83{\cdot}6$ A/m, $t_s = 2$ μsec., so that $c = 1{\cdot}17 \times 10^{-6}$ coulomb/metre.

Analysis of Shifting Process

Consider now the circuit of Fig. 13. This represents the coupling network of the shift register during the time that an output is being obtained from the first core. Examination of Fig. 12 shows that we may say as a reasonable approximation that the output from the core is

$$E \sin \omega t = \text{Im}\ (Ee^{j\omega t})$$

where $\omega = \dfrac{\pi}{t_s}$

The network equations may be written

$$ri_1 + \frac{1}{C}\int i_1 dt - \frac{1}{C}\int i_2 dt = Ee^{j\omega t}$$

and

$$-\frac{1}{C}\int i_1 dt + Ri_2 + \frac{1}{C}\int i_2 dt = 0$$

where r is the forward resistance of the diode (assumed constant), and it is understood that the imaginary parts of the solutions are required.

Solving in the usual way by means of Laplace transforms, we obtain

$$i_2 = \frac{E}{r + R + j\omega Cr}\left[\exp.\ (j\omega t) - \exp.\left(-t\,\frac{r+R}{Cr\,R}\right)\right] \quad .. \quad .. \quad (7)$$

At this point we may observe that the resistance R is a limiting resistor whose value will be made as large as possible (perhaps 100 Ω) while r is the forward resistance of the diode, which should be only a few ohms. As a first approximation we may say that $r/R \ll 1$, and neglect terms in r/R with respect to 1.

Applying this approximation to Equ. (7) gives

$$i_2 = \frac{E}{R(1 + j\omega Cr)}\left[e^{j\omega t} - e^{-\frac{t}{Cr}}\right] \quad .. \quad .. \quad (8)$$

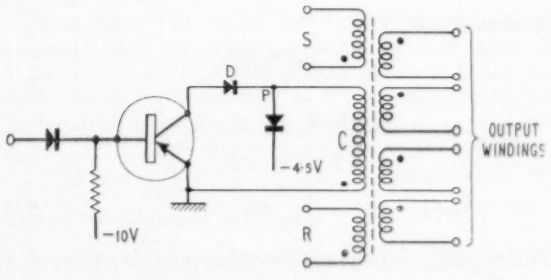

Fig. 9. *Eldridge's basic circuit*

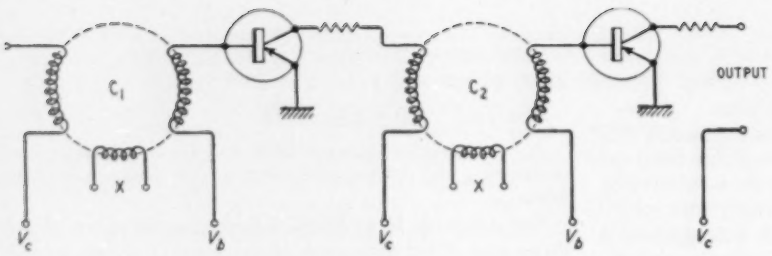

Fig. 10. *Newell's basic circuit*

Solving now for i_1, and again neglecting r/R with respect to 1, we have

$$i_1 = \frac{E}{r(1 + j\omega Cr)} \left\{ \left(j\omega Cr + \frac{r}{R} \right) e^{j\omega t} + e^{-\frac{t}{Cr}} \right\},$$

and taking the imaginary part

$$i_1 = \frac{E}{r(1 + \omega^2 C^2 r^2)} \left\{ \left(\frac{r}{R} + \omega^2 C^2 r^2 \right) \sin \omega t + \omega Cr \cos \omega t - \omega Cr\, e^{-\frac{t}{Cr}} \right\}$$

If the average value of i_1 over the time T is I_1,

$$I_1 = \frac{1}{T} \int_0^T i_1 dt = \frac{E}{T(1 + \omega^2 C^2 r^2)} \left[C + \frac{1}{\omega R} + \omega C^2 r\, e^{-\frac{T}{Cr}} \right]$$

which we may write as

$$I_1 = dE \quad .. \quad .. \quad .. \quad .. \quad .. \quad .. \quad (9)$$

where d is a constant.

Now the net current flowing into the capacitor is the difference between i_1 and i_2, and the voltage to which it is charged is given by

$$V_c = \frac{1}{C} \int_0^T (i_1 - i_2)\, dt$$

$$= \frac{E}{Cr(1 + j\omega Cr)} \left\{ j\omega Cr . \frac{1}{j\omega} e^{j\omega t} - Cr\, e^{-\frac{t}{Cr}} \right\}_0^T$$

$$= \frac{E}{1 + j\omega Cr} \left\{ j - e^{-\frac{T}{Cr}} \right\}$$

Taking the imaginary part,

$$V_c = \frac{E}{1 + \omega^2 C^2 r^2} \left\{ 1 + \omega Cr\, e^{-\frac{T}{Cr}} \right\}$$

$$\text{or } V_c = fE \quad .. \quad .. \quad .. \quad .. \quad .. \quad (10)$$

where f is a constant.

The time of charging, T, may be taken as being the time for the input e.m.f. to reach its peak value. This assumption is not unreasonable, for if the capacitor voltage followed the input voltage exactly, then after the input passed its peak the diode would be back-biased and further current flow prevented.

If we assume that the diode has an infinite reverse resistance, then after time T the capacitor discharges through the resistance R from its initial value V_c towards zero, and the current i_3 is given by

$$i_3 = \frac{V_c}{R} e^{-\frac{t}{CR}}$$

For the first T sec of discharge, the shift pulse is still holding the second core at '0', and if we suppose that the second core is to be switched in the same time, t_s, as the first one, then the average effective current is given by

$$I_3 = \frac{1}{2T} \int_T^{3T} i_3 dt$$

$$= \frac{V_c C}{2T} \left\{ e^{-\frac{T}{CR}} - e^{-\frac{3T}{CR}} \right\}$$

and since $V_c = fE$, we may write this as

$$I_3 = gE \quad .. \quad .. \quad .. \quad .. \quad .. \quad .. \quad (11)$$

where g is a constant.

If we now consider the complete circuit as shown in Fig. 14, then if H_1 is the field applied to core (1) by the shift pulse, and H_2 is the field applied to core (2) by the discharge of the capacitor, and if the numbers of turns on the winding are N_1, N_2 and N_3 as shown in Fig. 14, then we have from Equs (4), (5), (6), (9), (10), and (11)

$$H_1 = b(N_1 I - N_2 I_1); \quad H_2 = bN_3 I_3$$

$$I_1 = dE \qquad I_3 = gE$$

$$t_s = 2T = \frac{c}{H_1 - H_c} \qquad E = aN_2(H_1 - H_c) \ .$$

Also, since the two cores are switched in the same time,

$$H_1 = H_2$$

$$\text{so that } H_2 - H_c = \frac{c}{2T} \ .$$

By elimination,

$$H_2 = \frac{abcgN_2N_3}{2T} \ ,$$

$$\text{and so} \qquad \frac{abcgN_2N_3}{2T} = \frac{c}{2T} + H_c$$

$$\text{or} \quad N_2N_3 = \frac{1}{abg} + \frac{2T}{abcg} H_c \quad .. \quad .. \quad .. \quad (12)$$

This equation is used to determine suitable values of N_2 and N_3.

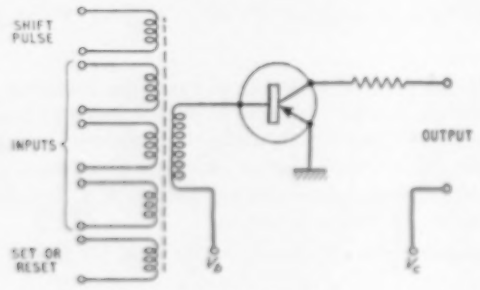

Fig. 11. *A basic logical unit*

Again, since $H_1 = H_2$, we have

$$b(N_1 I - N_2 I_1) = \frac{abcgN_2N_3}{2T} \quad ,$$

and substituting for I_1 in terms of T and the constants we obtain

$$N_1 I = \frac{acN_2}{2T}(dN_2 + gN_3) \qquad .. \qquad .. \qquad .. \quad (13)$$

This equation specifies the necessary shift pulse ampere-turns required.

This analysis enables us to complete a design for a shift register.

First of all, an approximation was made early in the analysis that r was very much smaller than R. Now in practice there is a limit to how small a value of r can be obtained. A good diode passing a heavy current may have 1 or 2 ohms forward resistance. To justify the neglect of r with respect to R therefore, we must make R large. However, it must not be made too large, for the capacitor discharge current must be made as large as possible. A compromise is to make R perhaps 100 Ω.

The next thing is to decide on the switchover time, $2T$, which has been regarded as one of the known constants for the purposes of the analysis. This choice determines the field required at each core, and also the

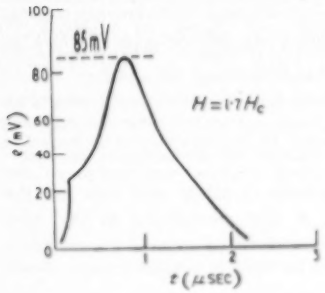

Fig. 12. *The output e against time t when a core is switched*

peak e.m.f. induced per turn of output winding. For the purpose of this discussion we will take T as 1 μsec, so that Fig. 12 represents the output per turn directly. In this case, $\omega = 1{\cdot}57 \times 10^6$, $H = 1{\cdot}7\,H_c$. From Equ. (10) we see that if V_c is to approach the maximum possible value, E, then

$$\omega Cr \ll 1$$

Also, from Equs (9) and (13) we see that if the shift pulse magnitude is to be kept down, d should be small. Both these considerations suggest that C should be made as small as possible.

From Equ. (11), we see that I_3 depends on C, and in order to find the optimum value of C to give the maximum value of I_3, for a fixed value of R, we may differentiate the equation. If C is small, then V_c may be regarded as a constant, and we have

$$\frac{2T}{V_c}\frac{dI_3}{dC} = C\left\{\frac{T}{RC^2}e^{-\frac{T}{CR}} - \frac{3T}{RC^2}e^{-\frac{3T}{CR}}\right\} + \left\{e^{-\frac{T}{CR}} - e^{-\frac{3T}{CR}}\right\}$$

and so for maximum I_3,

$$\left(1 + \frac{T}{CR}\right)e^{-\frac{T}{CR}} - \left(1 + \frac{3T}{CR}\right)e^{-\frac{3T}{CR}} = 0.$$

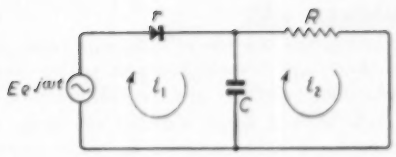

Fig. 13. *The equivalent circuit of the transfer network*

The solution to this equation may be obtained graphically, and we find $C = 0{\cdot}25\ \mu F$ approximately. However this value of C is too large to satisfy the other considerations mentioned, and $0{\cdot}1\ \mu F$ may be chosen to give a high value of V_c while maintaining I_3 near its maximum.

Having determined suitable values for r, R and C, the constants d, f and g may be calculated and we find that with $r = 1\ \Omega$, $R = 100\ \Omega$, $C = 0{\cdot}1\ \mu F$, we have

$$d = 0{\cdot}104, f = 0{\cdot}975, g = 0{\cdot}016.$$

Finally, the number of turns on the various windings must be decided. When discussing the system in general terms it was observed that N_2 must be greater than N_3 in order to prevent reverse digit transfer. Equ. (12) gives the required product N_2N_3, and a suitable pair of values could be chosen on this basis. However, Equ. (13) shows that in order to minimize the shift pulse ampere turns, N_2 should be as small as possible. Clearly a compromise must again be effected.

Substituting the values of the constants already obtained, we find that $N_2N_3 = 542$ and we may choose $N_2 = 34$, $N_3 = 16$.

Substituting now in Equ. (13), we have

$$N_1 I = 11 \text{ ampere turns.}$$

This could be achieved with 1/2 A pulse flowing through 22 turns.

Undoubtedly the worst feature of this system as it stands is the very large shift pulse which is required. For a complete machine employing large numbers of logical circuits the provision of a heavy current shift pulse presents serious difficulties. It is this consideration as much as any other which makes the use of a transistor in the basic logical unit desirable: the additional cost of the transistor is compensated by the reduced shift pulse required. In the Newell system described above, for example, the shift pulse required is only 3 ampere turns.

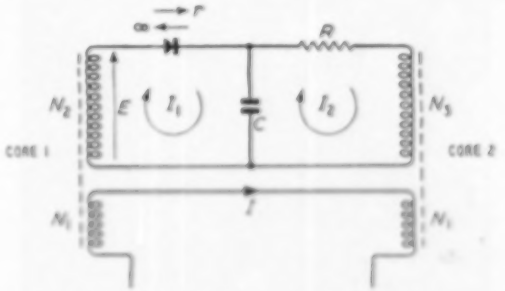

Fig. 14. *A complete shift register circuit*

Conclusions

In contemplating the use of magnetic cores as logical elements, there are several features to be considered. Their main disadvantages are the difficulty of winding a small core with a large number of turns, and the requirement for a shift pulse or in some cases several shift pulses; against this can be set their mechanical ruggedness, electrical stability, small size and light weight. Other properties which are being improved by research and development effort are their low-power consumption and low cost.

It is evident that magnetic cores have much in their favour as computing elements, and it seems possible that with improvements in ferrite materials, the use of magnetic core systems of logic may become much more widespread.

Acknowledgements

I gratefully acknowledge my debt to Dr. G. D. Sims and Dr. I. M. Stephenson, without whose encouragement and assistance this paper would never have been written.

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AUTOMATIC PRODUCTION OF RESISTORS

A new completely-automatic production line which is fully mechanized and controlled by a digital computer for making deposited-carbon resistors has been developed by the Western Electric Co., U.S.A. The production line consists of eleven stations or machines, each performing separate processes and all are controlled by a central computer. The feedback of data from three control points along the line permits rapid closed-loop operation of the plant.

The process begins with the deposition of carbon on a ceramic core and, throughout the whole of the production, the resistor is untouched by hand. After the deposition of the carbon film, the coated core goes between four probes and, using the Kelvin bridge principle, the carbon coating is checked against that required in the production programme.

The carbon-coated core is next transported to a terminating machine which sputters a gold contact film over each end; for this process small bell jars are used, one for each resistor (Fig. 1).

The next operation is capping. Here the end cap-lead assemblies are simultaneously pressed over both ends of the coated core with sufficient force to weld the gold plating of the caps to the sputtered gold on the ends of the core, producing a reliable low-noise contact.

Following the capping operation, resistors are fed to a helixing machine which cuts a spiral groove along the carbon film to raise the resistance to a desired value. A computer-controlled bridge is used at this stage to monitor the resistance value during cutting and to actuate a switch-off signal when the programmed resistance value is reached. During cutting, the bridge also senses any non-linearity indicative of chipping or thin spots in the coating; such cases are automatically rejected. At this point further process data is fed back to the computer for the self-correction of the helix lathe bridge; this is based on a statistical quality-control analysis of values checked after spiralling. A Wheatstone bridge, set to the desired nominal resistance value of each resistor batch by the computer, precisely measures the resistance of each individual resistor and, if there is a deviation from the nominal resistance value, an off-balance voltage is produced. This is digitized and fed back to the computer which then computes the desired correction and corrects the helixing-machine setting; out-of-limit resistors are automatically rejected.

Fig. 1. *The bell jars which are used in gold sputtering process*

The resistor next feeds into an encapsulating machine where a pre-cured epoxy-resin shell is fitted over the core and two partially-cured epoxy pellets are fitted over each lead. Held between resilient rubber chucks, the resistor moves through an oven at 300 °F to bond the end pellets to the shell and seal the resistor.

Moving along a conveyor from the oven, the resistor is picked up and immersed in a hot-water bath and ten photoelectric cells are used to indicate any leaks caused by the expansion of air inside the capsule; here, again, faulty resistors are automatically rejected.

A computer-controlled marking machine now stamps on the resistance value, production-batch number, and date on the transistor. Final inspection is then carried out at the third feedback control point and data is fed back to re-set the preceding inspection stage to compensate for shifts in resistance value caused by the heat of encapsulation.

Finally, the resistor moves on to a packing platform where it is positioned and pushed into a "Styrofoam" block.

The machines work on a 3-sec cycle, producing a maximum of 1,200 finished resistors per hour.

This completely-automatic production line has been developed primarily to produce resistors of high reliability. Until now, individual precision resistors have been made by manual or semi-automatic processes that can result in contamination from handling and are subjected to the shortcomings of human control. By adopting this method of production, it is claimed that contamination disappears as a problem, production is increased and a level of reliability is attained that manual-production methods cannot match.

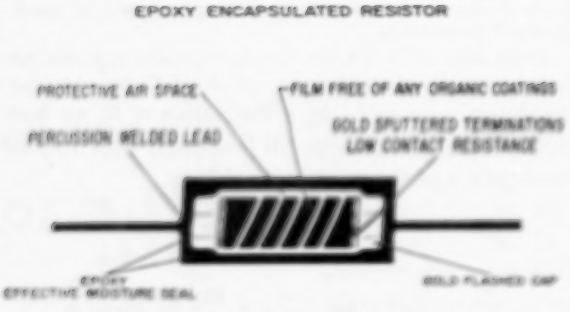


Fig. 2. *A drawing of the complete resistor*

ECHO

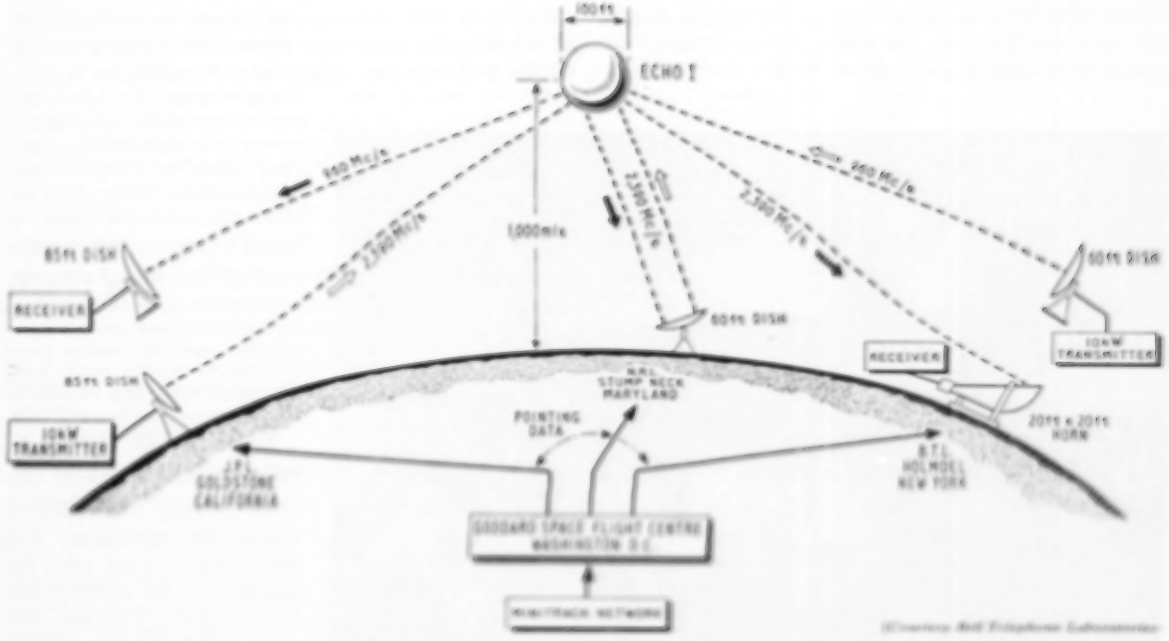
Some of you may have questioned the relevance to electronic technology of some of the subjects discussed in these articles. Why should you be interested in gravitation, in liquid helium, in the special and general theories of relativity, and in apparently esoteric mysteries like the self-energy of the electron?

It seems to me that Project Echo provides the perfect answer. As I looked through a collection of papers on this project, I found that very many of the things that were to me merely interesting side lines at the time when I discussed them have been worked into the heart of this enterprise. Liquid helium, the Doppler effect, the scattering cross-section of reflecting spheres (do you remember "Radar in the Rain", January 1958, p. 13?), masers, noise temperature, and of course Boltzmann's constant—all seem to be involved. The issue of the *Bell System Technical Journal* for July 1961 (Vol. XL, No. 4, "Participation of Bell Telephone Laboratories in Project Echo and Experimental Results", by William C. Jakes, Jr.) devoted to Project Echo, which is the use of a 100-foot balloon as a passive communication satellite, explains where they all fit in. If I may be allowed for once to coin a couple of phrases, it is Out of This World, but not Beyond the Fringe.

If your library has this Journal, you can break off now and relax. For the present article really only summarizes some of the main features—not with the intent to infringe, but simply to illustrate what might be called affringement—the way in which new discoveries quickly become technologies, and the rapid pursuit of technical progress in the wake of discovery nowadays.

The Echo I System

Echo I, launched on 12th August 1960, orbited the earth at an altitude of 1000 miles (Fig. 1), in a nearly circular path with an inter-passage interval which was initially 2 hr 6 min. Three stations, the Jet Propulsion Laboratory (JPL) at Goldstone, California; the Naval Research Laboratory (NRL) at Stampneck, Maryland; and Bell Telephone Laboratories (BTL) at Holmdel, New Jersey, participated in the main two-way transmission tests. The useful mutual visibility interval between BTL and JPL was about 15 minutes, and that between BTL and NRL about 25 minutes. The east-west channel used a frequency 960·05 Mc/s, and the west-east channel 2390 Mc/s; a transmitter–



(Courtesy Bell Telephone Laboratories)

Fig. 1. *General features of the Project Echo experiment. The Minitrack network provided the initial orbit observations, from which the whole system was closed to a satisfactory tape based on orbit predictions from the Goddard Space Flight Centre*

receiver at NRL enabled the west-east channel to function even after the balloon had "set" for JPL.

The radiations were circularly polarized—clockwise from JPL and counter-clockwise from BTL; reflection from the balloon surface reversed the sense of polarization (though there remained some unreversed signal, which a separate receiver picked up).

Preliminary tests on signals reflected from the moon (November 1959 to July 1960), Tiros I (April–July 1960) and a non-orbital balloon (October 1959 to February 1960) enabled various modulation systems to be tested. With the moon, the only effective speech reception was with single-sideband and amplitude modulation. When Echo was in orbit, however, frequency modulation with feedback (FMFB) was found greatly superior to SSB, to amplitude modulation and to narrow-band phase modulation. By September 1960 the successful transmission and reception of facsimile pictures had been achieved (Fig. 2).

Reception of signals at Jodrell Bank, at Malvern, in Scotland, and in France was also reported.

The Objects of the Exercise

Well, the system "worked". In the preliminary sighting shots left the team to expect. But the real object of this project was to obtain information about the propagation of signals, the effect of the atmosphere, the behaviour of the balloon, the systems of modulation, and the problems of tracking as much as object.

To begin with, when the balloon was low in the heavens from the point of view of one or other of the stations, the effect of atmospheric refraction, scattering loss, and absorption were considerable, and their extent was determined. Also, with the receiver directed almost horizontally, a great deal of thermal radiation was picked up from the ground and the atmosphere. Incidental noise-hazards were the sun itself (which added 4000 °K to the noise temperature if picked up in the main aerial beam), the moon, and radio stars; the centre of the galaxy contributed 4·5 °K.

The balloon itself, under the most favourable conditions, did behave as a perfectly reflecting sphere of 100-foot diameter. Random scintillations were observed, particularly intense at low altitudes, together with occasional signals far stronger than calculated for a sphere, which were attributed to a possible flattening of parts of the surface. The Doppler shift, on 2390 Mc/s, varied between the limits ± 57 kc/s in the early days to ± 80 kc/s in the later passages; this incidentally meant that there could be no confusion at the receiving end between reflected signals and those propagated directly by ionospheric scattering.

Losses and Noise

Propagation losses are of two kinds: the "inverse square" free-space loss, and that due to the earth's atmosphere. Both depend on the radius of the satellite's orbit, and vary with its position with respect to the two stations since the two separate distances to the stations are involved.

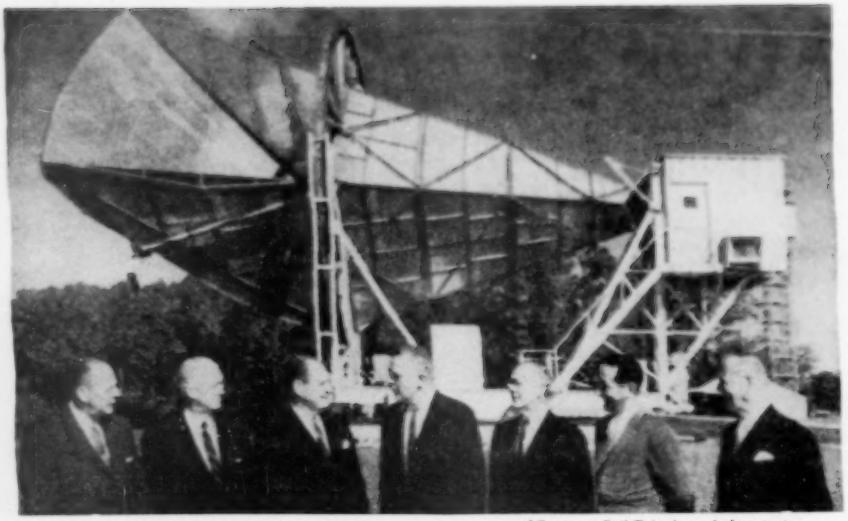
For the unitary position, the free-space loss calculated for a height of 1,000 miles is 183 dB. The increase with height is about 6 dB per thousand miles in the region. The usual law formula,

$$L = \frac{(4\pi)^2 d_1^2 d_2^2}{G_1 G_2 \lambda^2},$$

where d_1 and d_2 are the distances of transmitter and receiver from the reflector, G_1 and G_2 the respective aerial gains, δ the cross-section of the reflector, and λ the wavelength, shows that L increases very considerably as either d_1 or d_2 increases.

Let us extrapolate this for a moment to the case of a satellite permanently overhead; from the usual expression $r^3\omega^2$ = constant for all satellites of a given primary, it appears that the height would be about 23,000 miles, and d_1 and d_2 would each have this value. With Echo, 1000 miles up, for stations about 2000 miles apart, d_1 and d_2 each equal about 1400 miles; at 23,000 miles, then, the loss would have increased by *a factor* $23{,}000^4/1400^4 = 7 \times 10^4$; that is, by 48 dB. This seems rather surprisingly low, compared with the 183 dB for the first thousand miles; but the arithmetic seems all right. I haven't put in Boltzmann's constant the wrong way up, and it does look as though a "fixed" satellite of this size would operate with only 230 dB free-space path loss. The moon-echo loss, incidentally, works out to about 283 dB.

The noise for the whole system was the sum of two contributions, one arising within the apparatus, and one (which varied with the position of the satellite) due to radiation from the sky. The noise power, written in the usual form $kT\Delta f$, where k is Boltzmann's



[Courtesy Bell Telephone Laboratories

Fig. 2. *Reproduction of the facsimile picture as received at BTL from NRL on 22nd September* 1960

Optimal Lumped Loading

By G. [illegible]*

The ratio of power dissipated to power transmitted in a finite length of transmission line may be smaller when the line has standing waves than when the termination is reflectionless. The termination which minimizes that ratio is found in this paper. This leads directly to the idea of a cascade of finite sections separated by lossless networks serving to present each section with the termination impedance which minimizes the ratio. The network is defined implicitly in terms of terminating and input impedances, which are, however, explicitly defined in terms of the parameters of the line. A numerical example is worked out to illustrate the reduction in loss which can be expected, and to illustrate that the line thus loaded has no high-frequency cut-off.

Consider a length of a uniform two-wire transmission line whose primary and secondary parameters are

series impedance per unit length $= R + j\omega L$
shunt admittance per unit length $= G + j\omega C$

$$\left.\begin{aligned} \text{propagation constant} \quad &= \gamma = \alpha + j\beta = \sqrt{(R + j\omega L)\,(G + j\omega C)} \\ \text{characteristic impedance} = Z_0 &= R_0 + jX_0 = \sqrt{(R + j\omega L)/(G + j\omega C)} \\ &= |Z_0|\, e^{j\phi}. \end{aligned}\right\} \quad \cdots \quad (1)$$

What is the most efficient way to use this line to transmit power from one point to another?

The following specific example shows why the question is interesting. Suppose that the length l is very small (much smaller than one wavelength) so that currents and voltages are nearly uniform throughout its length. Suppose that the conductance G is zero. Suppose the line is terminated in a resistance R_t, and suppose the load current is $Ie^{j\omega t}$. Then

load voltage $= IR_t e^{j\omega t}$
load power $= I^2 R_t/2$
dissipated power $= I^2 Rl/2$

We can define a plausible kind of 'efficiency':

$$\text{efficiency} = \frac{I^2 R_t/2}{I^2 R_t/2 + I^2 Rl/2} = \frac{R_t}{R_t + Rl} \quad \cdots \quad (2)$$

Obviously the efficiency can be made arbitrarily close to unity by increasing the termination resistance, independent of the characteristic impedance. This fact is exploited in 60-c/s power transmission, where efforts are made to transmit at higher and higher voltages; i.e., with higher and higher terminating impedances. On the other hand, in communications electronics we normally use a matched termination, and the efficiency is only

$$\text{efficiency} = \frac{R_0}{R_0 + Rl} \quad \cdots \quad \cdots \quad \cdots \quad \cdots \quad (3)$$

* *Bell Telephone Laboratories, Inc. Now at Arthur D. Little, Inc.*

which is, for fixed l, constant and less than unity. In this case it appears that when R_t is greater than R_0, a line with a mismatched termination may be more efficient than a matched line.

Let us go a little deeper into the matter, and consider a uniform line of arbitrary length and parameters. Suppose the line is carrying simultaneous travelling waves in both directions: how rapidly is power lost from the travelling waves, and where does it go? Suppose the travelling current and voltage in the two waves are

$$\left\{\begin{matrix} I_1 e^{j\omega t-\gamma x} \\ Z_0 I_1 e^{j\omega t-\gamma x} \end{matrix}\right\} \text{ and } \left\{\begin{matrix} I_2 e^{j\omega t+\gamma x} \\ -Z_0 I_2 e^{j\omega t+\gamma x} \end{matrix}\right\} \quad .. \quad .. \quad (4)$$

The powers in the two waves are (counting power flowing in the $+x$ direction as positive)

$$P_1 = \frac{R_0}{2} |I_1|^2 e^{-2\alpha x}, \; P_2 = -\frac{R_0}{2} |I_2|^2 e^{+2\alpha x} \quad .. \quad (5)$$

However, the total power transmitted down a line is not the sum of the powers in the two travelling waves, for:

$$\begin{aligned} P_{tot} &= \tfrac{1}{2} \text{ Re } (I_{tot} V^*_{tot}) \\ &= \tfrac{1}{2} \text{ Re } [(I_1 e^{-\alpha x - j\beta x} + I_2 e^{+\alpha x + j\beta x}) \; (I_1^* Z_0^* e^{-\alpha x + j\beta x} \\ &\qquad - I_2^* Z_0^* e^{+\alpha x - j\beta x})] \\ &= \tfrac{1}{2} R_0 (|I_1|^2 e^{-2\alpha x} - |I_2|^2 e^{+2\alpha x}) \\ &\qquad + j X_0 (I_1 I_2^* e^{-2j\beta x} - I_1^* I_2 e^{+2j\beta x})/2 \quad .. \quad (6) \end{aligned}$$

Note that the expression in the last parenthesis is a pure imaginary, so the expression as a whole is real. This second term is usually small compared to the first, and is often ignored.

By differentiation, we can find the total dissipation per unit length

$$\begin{aligned} D &= \alpha R_0 [|I_1|^2 e^{-2\alpha x} + |I_2|^2 e^{+2\alpha x}] \\ &= -\beta X_0 [I_1 I_2^* e^{-2j\beta x} + I_1^* I_2 e^{+2j\beta x}] \quad .. \quad (7) \end{aligned}$$

We would like to believe that the total power moving on a transmission line is the sum of the powers in individual travelling waves, yet Equ. (6) shows that this is not so. The reason for this is revealed in Equ. (7). In a transmission line with standing waves, the dissipation is ordinarily non-uniform. The local peaks of dissipation occur at the current maxima if resistance losses are predominant, and at the voltage maxima if conductance losses are predominant. The unexpected second term of Equ. (6), which we may call standing-wave power, represents the transport of energy from the areas of low dissipation to the areas of high dissipation. Over a complete half-wavelength of line, the standing-wave power represents no net transport of energy from one end to the other, but only a re-distribution. Notice that the second term in Equ. (7) may be significant compared to the first, even when the second term in Equ. (6) is very small. Observe also that in a 'distortionless' line, where $R/\omega L = G/\omega C$, the characteristic impedance Z_0 is a pure real number, X_0 vanishes, and the standing-wave power is zero.

If the length of the transmission line segment is not an integer multiple of one-half wavelength, there still exists the possibility of using the standing-wave power to carry energy from one end to the other. Of course, this alters the pattern of dissipation, but the example given at the beginning of the article shows that the net result may be to reduce losses. Let us ask in general terms how should a finite length of uniform transmission line be terminated to maximize in power transmission efficiency?

The problem is algebraically complex. However, by making the problem as symmetrical as possible, the algebra can be overcome.

Take a length of line stretching from an input at $x = -l/2$ to an output at $x = +l/2$. Let the relation between the phase and amplitude of I_1 and I_2 be defined by

$$I_2 = I_1 e^{u+j\theta} \quad .. \quad .. \quad .. \quad .. \quad .. \quad (8)$$

Define an effective attenuation coefficient α' by the relation

$$P_{out} = P_{in} e^{-2\alpha' l} \quad .. \quad .. \quad .. \quad .. \quad .. \quad (9)$$

where P_{in} and P_{out} are the power delivered to the line at $x = -l/2$ and the power delivered by the line at $x = +l/2$, respectively. Tedious but elementary algebra shows that

$$\begin{aligned} \tanh \alpha' l &= \frac{P_{in} - P_{out}}{P_{in} + P_{out}} \\ &= \frac{R_o \cosh u \sinh \alpha l - X_o \cos \theta \sin \beta l}{-R_o \sinh u \cosh \alpha l + X_o \sin \theta \cos \beta l} . \quad (10) \end{aligned}$$

Application of differential calculus reveals that the minimum value of $\tanh \alpha' l$ is given by the relation

$$\tanh^2 \alpha' l = \frac{R_0^2 \sinh^2 \alpha l - X_0^2 \sin^2 \beta l}{R_0^2 \cosh^2 \alpha l + X_0^2 \cos^2 \beta l} \quad .. \quad (11a)$$

$$= \tanh^2 \alpha l \frac{1 - \tan^2 \phi \sin^2 \beta l \cosh^2 \alpha l}{1 + \tan^2 \phi \cos^2 \beta l \operatorname{sech}^2 \alpha l} \quad (11b)$$

$$= \frac{\cos^2 \phi \sinh^2 \alpha l - \sin^2 \phi \sin^2 \beta l}{1 + \cos^2 \phi \sinh^2 \alpha l - \sin^2 \phi \sin^2 \beta l} \quad (11c)$$

These expressions are never negative, and we choose the positive square root. The minimum value of $\tanh \alpha' l$, and consequently of α', is attained when

$$\begin{aligned} \tan \theta &= \cot \beta l \tanh \alpha' l \\ \tanh u &= -\coth \alpha l \tanh \alpha' l \quad .. \quad .. \quad .. \quad (12) \end{aligned}$$

The ambiguity in θ is resolved by the condition

$$\left.\begin{matrix} X_0 \cos \theta \sin \beta l \geqslant 0 \\ X_0 \sin \theta \cos \beta l \geqslant 0 \end{matrix}\right\} \quad .. \quad .. \quad .. \quad .. \quad (13)$$

which are compatible with Equ. (12). There is no ambiguity in u, which is always negative. It is illuminating to notice that if the line is terminated without reflection (i.e., $I_2 = 0$) then $\alpha' = \alpha$; and that the fraction in Equ. (11 b) above is the factor by which $\tanh^2 \alpha' l$ is improved when appropriate standing waves are introduced.

The terminating impedance is formed by dividing the output voltage by the output current. Its value is*

$$Z_T = -Z_0 \tanh (u + i\theta + \gamma l)/2 \quad .. \quad .. \quad (14)$$

$$= \frac{2 R_0^2 (A \cosh^2 \alpha l - B \sinh^2 \alpha l) + 2 X_0^2 (A \cos^2 \beta l + B \sin^2 \beta l)}{(B - A) (R_0 \sinh 2 \alpha l + X_0 \sin 2 \beta l)}$$

$$- j \frac{R_0 X_0 (\cosh 2 \alpha l - \cos 2 \beta l)}{R_0 \sinh 2 \alpha l + X_0 \sin 2 \beta l} \quad .. \quad .. \quad .. \quad .. \quad (15)$$

* The identity $\tanh (x + iy) = \dfrac{\sinh 2x + i \sin 2y}{\cosh 2x + \cos 2y}$ overcomes the major obstacles in arriving at Equ. (14). All the ambiguous signs are uniquely resolved.

where

$$A = (R_0^2 \sinh^2 \alpha l - X_0^2 \sin^2 \beta l)^{\frac{1}{2}}$$

$$B = (R_0^2 \cosh^2 \alpha l + X_0^2 \cos^2 \beta l)^{\frac{1}{2}}$$

$$B^2 - A^2 = R_0^2 + X_0^2 \quad .. \quad .. \quad .. \quad .. \quad (16)$$

The value of the input impedance Z_{in} is the complex conjugate of Z_T. From this one can see that a section of line of length l fed from a source with impedance Z_T and working into a load Z_T sees a conjugate impedance match at each end. The conjugate impedance matching condition is an alternative formulation of the problem, and leads equally well to Equs (11) and (12) above†.

Inasmuch as Z_T and Z_{in} have positive real parts, they can be approximated over a finite range with realizable lumped-constant networks.

A few special cases will illustrate the applications which might be made of these relations. As a first example, suppose the transmission line is very short, so that

$$\left.\begin{array}{l} \sinh \alpha l \simeq \alpha l, \cosh \alpha l \simeq 1, \\ \sin \beta \simeq \beta l, \cos \beta l \simeq 1 \end{array}\right\} \quad .. \quad .. \quad .. \quad (17)$$

then‡

$$\left.\begin{array}{l} \tanh^2 \alpha' l = l^2 \dfrac{R_0^2 \alpha^2 - X_0^2 \beta^2}{R_0^2 + X_0^2} \\ \quad = l^2 RG \\ \quad \alpha' \simeq \sqrt{RG} \\ Z_T \simeq \sqrt{R/G} + j\omega l(RC - LG)/2G \\ Z_{in} \simeq \sqrt{R/G} - j\omega l(RC - LG)/2G \end{array}\right\} \quad (18)$$

These are precisely the values of attenuation and termination impedance for the same line loaded with continuous magnetic loading L' per unit length, where L' is chosen so that

$$\frac{L + L'}{C} = \frac{R}{G} \quad .. \quad .. \quad .. \quad .. \quad .. \quad (19)$$

or, in the rare case of a line with more conductive loss than resistive loss, a capacitively-loaded line with dielectric loading C' such that

$$\frac{L}{C + C'} = \frac{R}{G} \quad .. \quad .. \quad .. \quad .. \quad .. \quad (20)$$

This suggests that there may be some relation between a loaded line and a line with standing waves. The comparison is made clear by imagining segments of transmission line of length l joined in tandem with lossless four-terminal networks T. This is a form of periodic loading slightly more general than loading with simple series or shunt elements.

We can now ask, for what network T is the over-all attenuation of the composite system minimized, and what is the resultant attenuation? The answer is immediately obvious from the analysis in the preceding pages: T is a lossless network whose input impedance is Z_{in} when its termination impedance is Z_T [Z_{in} and Z_T are given by Equs (14) and (16)]; and the resultant attenuation is α' [Equ. (10)].

From the particular example above, we see that T is a simple series inductance $l(RC - LG)/G$ when l is very small. However, we know that lumped coil loading fails for spacing l greater than one-quarter of a wavelength, whereas equations (11) above show that α' is less than the unloaded α for lengths at least up to one-half wavelength.

From the fact that Z_T and Z_{in} are complex conjugates, it follows that at any one frequency it is possible to realize the network T with a single series reactive element.

$$jX_T = Z_T - Z_{in} \quad .. \quad .. \quad .. \quad .. \quad (21)$$

or a shunt reactive element

$$jB_T = Z_T^{-1} - Z_{in}^{-1} \quad .. \quad .. \quad .. \quad .. \quad (22)$$

The practical problem resides, of course, in finding a single network which gives the right impedance transformation over a band of frequencies.

In Equ. (14)

$$\left.\begin{array}{l} R_0 > 0 \\ X_0 < 0 \text{ in the usual case where } R/L > G/C \\ R_0 \sinh 2\alpha l + X_0 \sin 2\beta l > 0 \end{array}\right\} \quad (23)$$

and so the sign of X_T is always positive; i.e., inductive. For long lines its asymptotic value is

$$X_T = -2X_0 \quad .. \quad .. \quad .. \quad .. \quad .. \quad (24)$$

To use simple series loading, one would need series elements whose reactances are initially proportional to frequency, but then decrease asymptotically to zero, according to Equs (15) and (21). Such behaviour violates Foster's reactance theorem. However, there is no objection in principle to realizing the desired behaviour with four-terminal networks.

When the length l is many wavelengths,

$$Z_T \simeq R_0 - jX_0 \quad .. \quad .. \quad .. \quad .. \quad .. \quad (25)$$

This case is discussed in Ref. 5.

Frequency in kc/s	Unloaded Attenuation in nepers per 6,000 ft.	Loaded Attenuation in nepers per 6,000 ft.
1·00	0·275	0·0446
1·26	0·308	0·0562
1·58	0·344	0·0708
2·00	0·385	0·0890
2·51	0·429	0·112
3·16	0·478	0·141
3·98	0·532	0·177
5·01	0·590	0·221
6·31	0·654	0·227
7·94	0·721	0·345
10·0	0·792	0·427
12·6	0·866	0·524
15·8	0·941	0·636
20·0	1·016	0·760
25·1	1·088	0·890
31·6	1·157	1·017
39·8	1·221	1·129
50·1	1·281	1·216
63·1	1·339	1·282
79·4	1·398	1·352
100·0	1·466	1·438

† Personal communication of Dr. W. R. Bennett, who showed that the present results are equivalent to those of R. S. Johnson, "Transmission Circuits for Telephonic Communication" (New York, Van Nostrand, 1925), page 52.

‡ The reader will find the derivations of these relations simplified by using the relations in Equs 38–42 of Ref. 5.

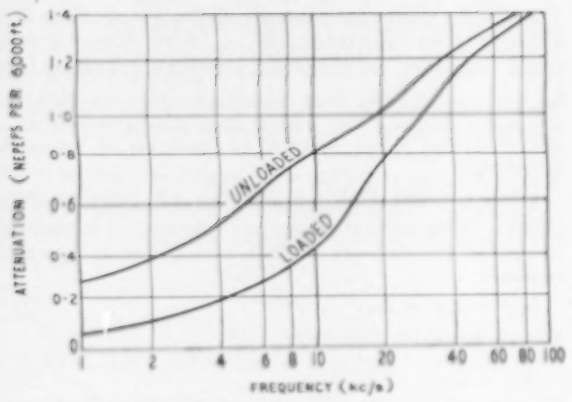


Fig. 1. *Attenuation of a typical transmission line with optimal four-terminal loading, compared to attenuation of same line without loading*

The following example was worked out to illustrate the kind of behaviour which might be expected from optimal four terminal loading in a practical case. Suppose

f = frequency in kc/s
$R = 265 + 0{\cdot}0316f^{3/2}\ \Omega$/mile
$L = 913{\cdot}10^{-6} - 0{\cdot}200{\cdot}10^{-6}f$ henry per mile
$G = 10^{-12}f^{4/3}$ mho/mile
$C = 7{\cdot}2{\cdot}10^{-8}$ F/mile

For the range of $0 < f < 100$, these are roughly within the range of parameters of 24 gauge 0·072 μF telephone exchange area cable.

The attenuation has been computed for the unloaded line and for a line with optimum lossless four-terminal loading networks spaced at 6·000-ft intervals. The results are given in the table, and also in Fig. 1. At 20·5, 49·8, 78·7, and slightly over 100 kc/s, the spacing of the networks is 1/4, 1/2, 3/4, and 1 wavelength respectively.

The importance of this example lies not in the particular loading technique, but in the insight we can get into the behaviour of nonuniform periodic transmission lines. Several articles have recently appeared[1,2,3] showing how periodic variation of transmission-line parameters may lead to reduction of losses or other interesting transmission properties. Bearing in mind Schelkunoff's work[4], we can see an equivalence between any travelling wave in a uniform guiding medium and a travelling wave on an appropriately chosen two-wire line. The present example shows in complete detail how two travelling waves on a transmission line can interact to produce power transfer in unexpected ways. The same can therefore be expected in other structures which support more than one travelling wave.

Among generalizations one can draw are the following: if the medium is lossless, or even if the electric vector E and the magnetic vector H are in phase at each point in every travelling wave (the analogue of a real surge impedance), an effect like the one described in the present paper will not be found.

Acknowledgements

The stimulation of Professor R. A. Chipman's paper[5] is acknowledged with pleasure. I am indebted to Mr. A. Pal for programming computations on which the table and Fig. 1 are based; and to Dr. W. R. Bennett for his counsel.

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SOLID-STATE ULTRASONIC AMPLIFIER

A new class of solid-state electronic devices such as amplifiers, oscillators, delay lines and isolators now appears possible due to a development by Bell Telephones which is based on the combination of the piezoelectric and semiconductor phenomena in certain crystals.

This development has shown that, under certain conditions, ultrasonic waves can be amplified directly in a piezoelectric semiconductor crystal. The sound waves are amplified by interaction with electrons drifting in the crystal, in much the same way that e.m. waves are amplified in a travelling-wave tube.

Direct amplification of high-frequency sound waves is possible because a sound wave travelling in a piezoelectric material produces a longitudinal electric field which travels along with the wave. If the material is also conductive, the electric field will cause currents to flow in the material. Because the piezoelectric field is periodic the electrons bunch together in parts of the ultrasonic wave. The bunched electrons tend to interact with the piezoelectric field and consequently react back on the material, changing the velocity and amplitude of the sound waves. Therefore if an appropriate d.c. electric field is impressed on the material, such that the bunched carriers are made to drift in the direction of the wave propagation faster than the speed of sound, the sound wave will be amplified similarly to the way e.m. waves are amplified in a t.w.t.

The amount of amplification obtained depends on the applied voltage and the conductivity of the material. Cadmium sulphide was used in the experiment because large single crystals are available which are strongly piezoelectric and have the required semiconducting properties. Since cadmium sulphide is also photoconductive, the conductivity can be adjusted to the optimum value for amplification by shining light on the crystal.

With this technique, gains of 18 dB in a 15-Mc/s wave and 38 dB in a 45-Mc/s wave travelling through a 7-mm length of cadmium sulphide have been achieved.

TELEPHONE CABLES

Associated Electrical Industries Ltd., and Enfield Cables Ltd., have now transferred all their business in paper-insulated and polythene-insulated telephone cables and in coaxial and other high-grade cables for telecommunications to Telephone Cables Ltd., Chequers Lane, Dagenham, Essex. Telephone Cables is jointly owned by A.E.I. and Enfield Cables.

DIRECTOR, ROYAL RADAR ESTABLISHMENT

The Ministry of Aviation have recently announced that Dr. G. G. Macfarlane, at present Deputy Director of the National Physical Laboratory of the Department of Scientific and Industrial Research, is being appointed Director of the Royal Radar Establishment.

Dr. Macfarlane will take up his new duties in the early part of 1962.

Silicon P-N-P-N Switch—2

PRACTICAL APPLICATIONS

By A. Bardsley*, B.Sc. and J. Walker*

In Part 1 of this paper the characteristics of the p-n-p-n diode were discussed. Various aspects of the device design were considered, particularly the effects on performance of alteration of the basic parameters.

It is now proposed to indicate briefly some of the many applications of this two-state device or switch. To fire the device (i.e., to switch to a low-impedance state), the voltage across it must reach the trigger voltage V_T. In the devices considered this is 100 V ± 10%. To retain the switch in this ON condition the current through it must be maintained at a value at least equal to the holding current I_H. Devices are usually selected to be within a stated range of holding current. To switch the device to the high-impedance state the ON current

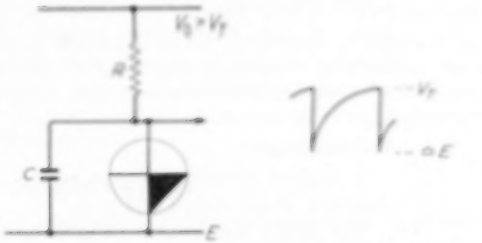

Fig. 1. *The basic relaxation oscillator using a p-n-p-n switch and the resulting output waveform*

must be reduced below the value for I_H, which may be done either by increasing the series impedance or by momentarily reverse biasing the switch.

The Relaxation Oscillator

The basic oscillator circuit is shown in Fig. 1.

The capacitor C charges exponentially through the resistor, until the voltage across the switch reaches V_T. The switch fires and the capacitor is rapidly discharged. If the resistor R is large, the ON current will fall below I_H, the switch will revert to the OFF state and the cycle will be repeated.

The sawtooth voltage waveform may be modified by connecting a resistor in series with the capacitor. Fig. 2 indicates the pulses produced for increasing values of R_1.

The maximum width of pulse for a given capacitor is obtained when

$$R_1 = \frac{V_T R}{2{\cdot}718\,(RI_H - V_0) - (V_T - V_0)}$$

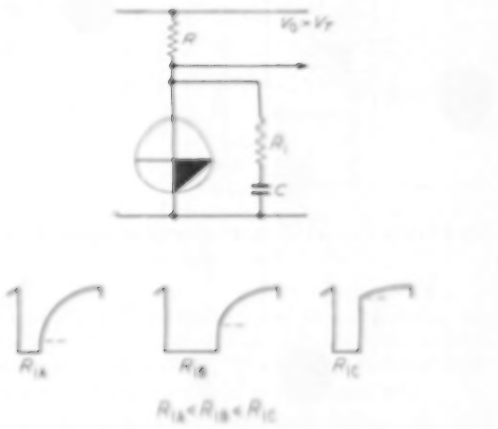

Fig. 2. *Shows the effect on the sawtooth voltage waveform of changing the value of* R_1

and the height of the positive-going edge is given by

$$R_1\left(I_H - \frac{V_0}{R}\right)$$

As stated in the previous article the trigger voltage is temperature dependent and thus the frequency will also vary with temperature. This effect may be reduced by operating the oscillator from a supply voltage well in excess of the trigger voltage, such that the point V_T occurs on the initial steep part of the charge curve for the capacitor.

For a given device there is a minimum capacitance

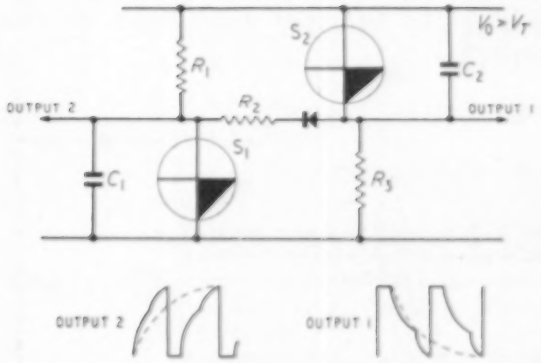

Fig. 3. *Illustrates a two-diode oscillator circuit in which the frequency of oscillation is increased*

* *Ferranti Ltd., Electronics Dept., Manchester.*

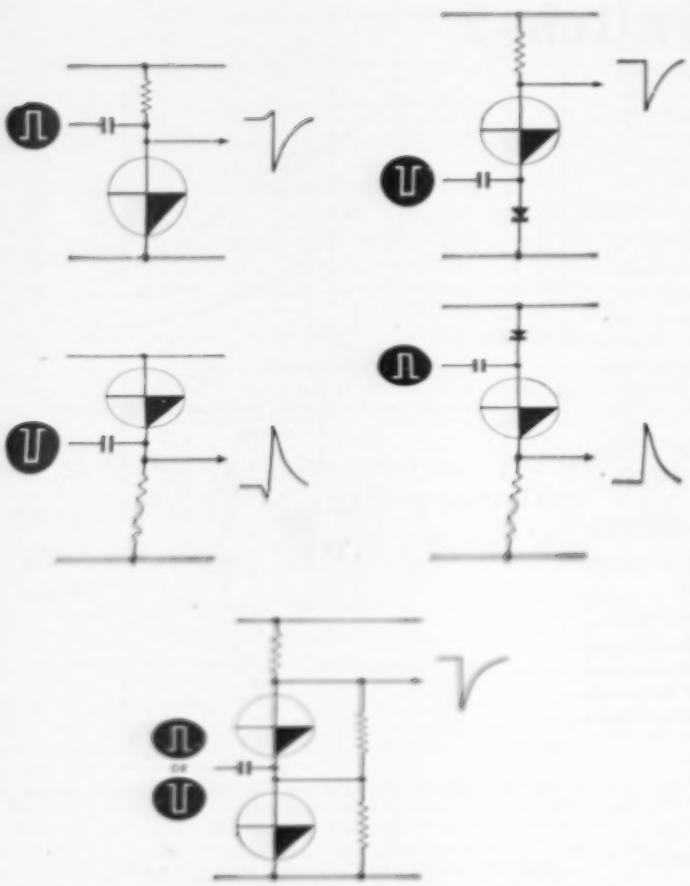

Fig. 4. Five typical triggered pulse generators using the p-n-p-n switch

required across the switch for satisfactory operation. The series limiting resistor must prevent the steady-state current from reaching I_H for oscillation to take place and has thus a minimum value. Thus at a fixed supply voltage the maximum frequency is decided by the minimum RC time constant.

Theoretically a much higher repetition rate would be achieved if the limiting resistor could be short circuited during the charging time of the capacitor and reinserted for the period during which the switch conducts.

Fig. 3 shows a circuit configuration which approaches this theoretical condition.

When the supply voltage V_0 is applied S_2 fires and a positive pulse appears across R_3 (output 1). Output 2 voltage begins to rise exponentially as C_1 charges through R_1. The positive pulse across R_3 is applied to C_1 via the diode and R_2. C_1 and R_2 form an integrating circuit such that the voltage increase across S_1 due to the pulse from S_2 is rapid but has a delay to ensure that S_2 has switched off before S_1 fires. When S_1 fires, a negative pulse is fed back to S_2. The integrating circuit in this case is R_2, C_2 and again the charging period is reduced. The dotted line indicates the normal charging curve of either switch if the two circuits were separated.

Triggered Pulse Generators

If the applied voltage is reduced below the trigger voltage the switch will not fire. When a voltage pulse is applied to the circuit, of such a polarity that it adds to the supply voltage, the total voltage across the switch can be raised above V_F, operating the device. Fig. 4 gives several typical triggered pulse generators. The use of a series diode creates a high input impedance. The input impedance of the other type consists of the limiting resistor in parallel with the impedance of any following circuitry.

Stroboscope

A typical example of the switch as an oscillator is the circuit of Fig. 5.

The EN15 flash tube requires a trigger pulse of at least 150 V and will operate up to 250 flashes per second. To obtain this amplitude of pulse, two switches are used in series with equalizing resistors and produce a pulse of approximately 200 V. The frequency is altered by varying the RC time constant. The resistor is calibrated in two ranges for two values of capacitor.

Higher intensity flash tubes such as the EN60 require trigger pulses of 1500 V. A pulse transformer in series with a single switch and the appropriate discharge capacitor will produce up to 6000 V pulses across the secondary winding.

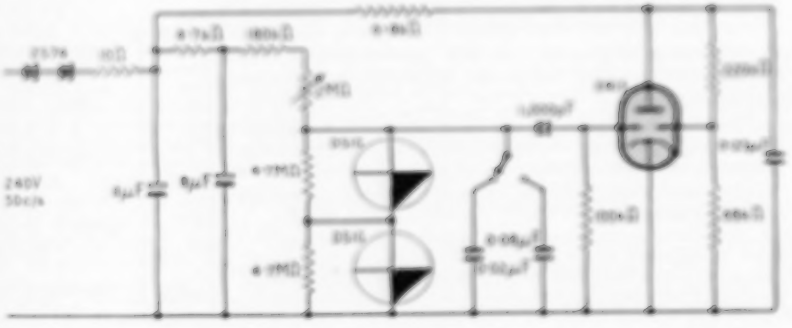

Fig. 5. *In this circuit two p-n-p-n switches are used to provide a trigger source for a stroboscope flash tube*

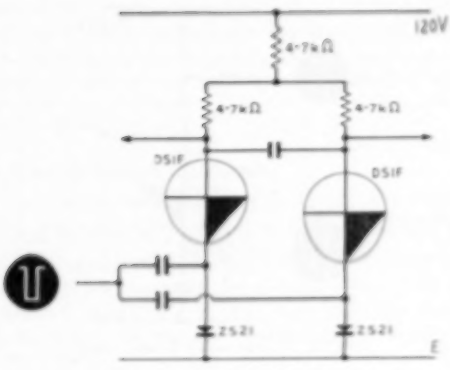

Fig. 6. A bistable or flip-flop circuit

The Bistable or Flip-Flop Circuit

In the circuit shown in Fig. 6 the limiting resistors permit current in excess of the holding value to flow, so that on application of the h.t. voltage, one switch will fire and a stable ON condition will be reached. The voltage dropped across the common resistor, reduces the voltage remaining across the other switch, ensuring it remains in the OFF condition.

When a trigger pulse is applied to both circuits, the pulse is short circuited by the forwardly-biased diode in the ON stage. The pulse to the OFF stage adds to the voltage across the switch and fires it. The increasing current in the load resistor generates a negative pulse which is fed by the capacitor to turn off the first switch. The circuit as a whole is switched to its second stable state. Output voltages can be obtained from across either or both switches.

Ring Counter Circuits

Fig. 7 illustrates a typical pnpn diode application. As in the previous circuit, an application of h.t. voltage, one switch fires and remains in the ON condition, the remaining switches being held off by the voltage developed across the common resistor. A positive voltage thus appears at the appropriate output terminal.

The applied trigger pulse reverse biases the ON switch, its current thus falls below the holding value and the switch reverts to the OFF condition. As the current falls, a negative pulse developed across the load resistor is applied via the capacitor to the adjacent stage. This voltage pulse adds to the rising voltage across the switch and turns it on. A second stable state is reached. Thus successive pulses transfer the ON state around the ring of switches.

An inversion of the whole circuit will produce pulses of negative polarity.

When these sequential outputs are used to control diode gating circuits, a high-speed sampling switch can be made. The number of stages being infinitely large.

Alternatively, if the load resistors are replaced or partially replaced by suitable lamps, the circuit can be adapted for use in visual read out equipment.

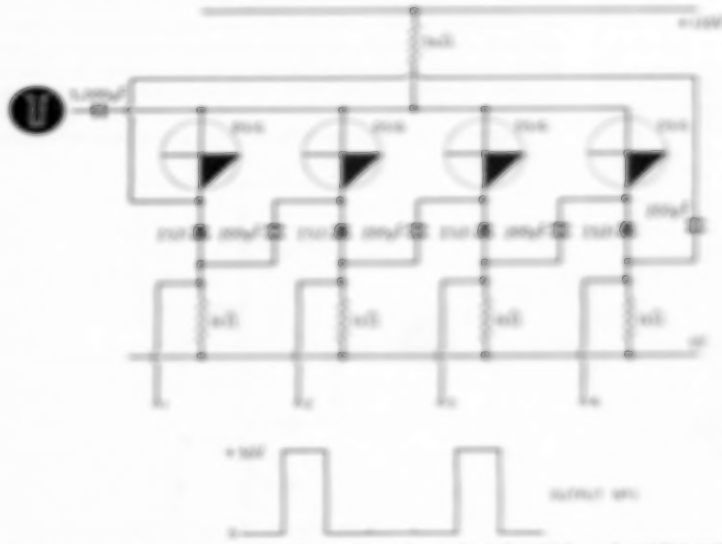

Fig. 7. A ring counter circuit which could also be used as the basis for a high-speed sampling switch

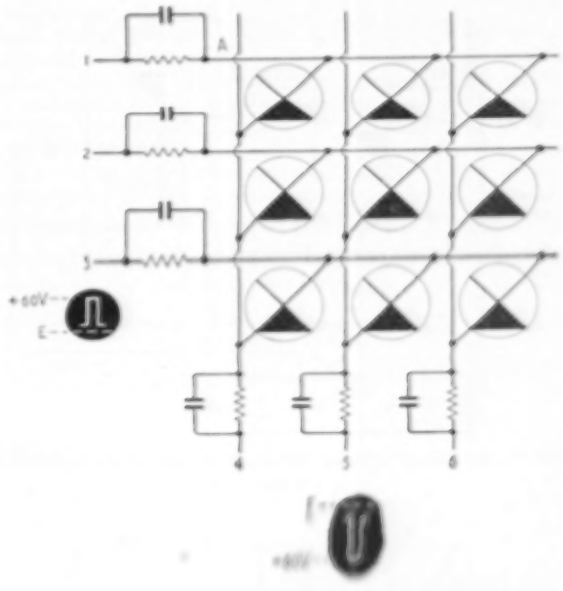

Fig. 8. Illustrates an application of the pnpn diode as a cross-point switch for telephone lines

Line Switching in Automatic Telephone Systems

Circuits have been developed* utilizing the high ratio of OFF to ON impedance of the four-layer diode. The low ON impedance permits the flow of speech currents with little attenuation. The basic circuit of Fig. 8 illustrates this.

To connect lines 1 and 4 at A, the pulses shown are applied simultaneously to these lines. These pulses, being of

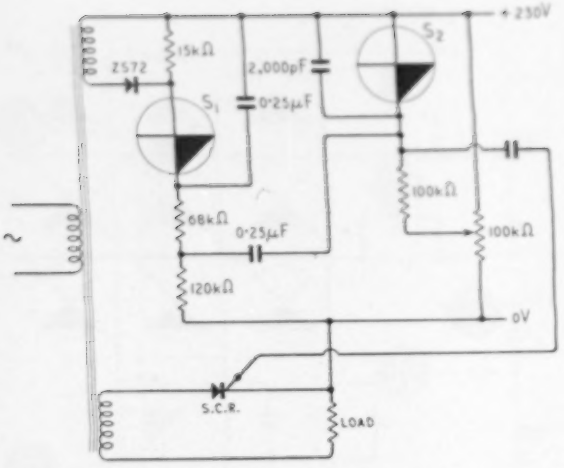

Fig. 9. *A circuit of a phasing unit for the operation of silicon controlled rectifiers* (Patented)

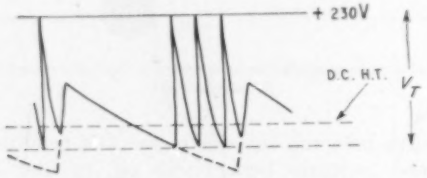

Fig. 10. *The output waveform S_2 of Fig. 9 for a particular h.t. voltage*

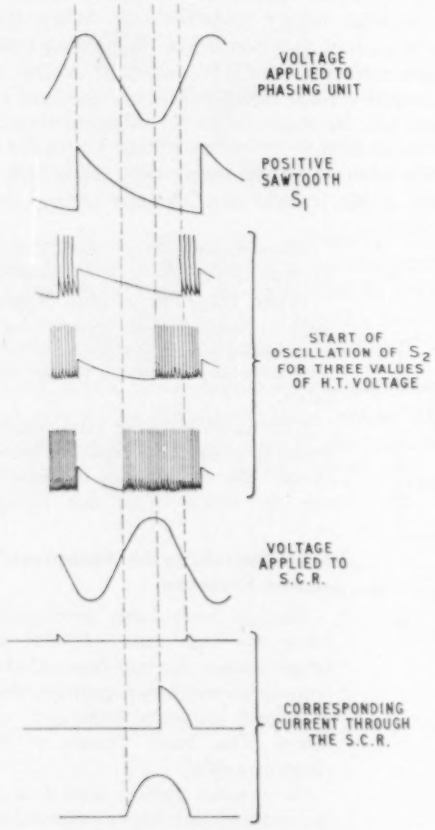
VOLTAGE APPLIED TO PHASING UNIT
POSITIVE SAWTOOTH S1
START OF OSCILLATION OF S2 FOR THREE VALUES OF H.T. VOLTAGE
VOLTAGE APPLIED TO S.C.R.
CORRESPONDING CURRENT THROUGH THE S.C.R.

Fig. 11. *Shows the relevant waveforms of the circuit of Fig. 9*

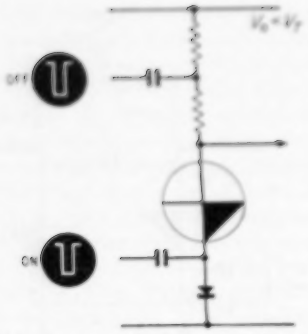

Fig. 12. *A single-ended bistable circuit*

opposite polarity, are additive and the switch at A is triggered into its low impedance state. On completion of the pulse, the residual low d.c. voltages at the two trigger inputs, hold the switch in the ON condition via the limiting resistors. On completion of the call, a contact (not shown) in series with the holding circuit is opened and the switch reverts to the high impedance state. The steady ON current is set at such a value that the negative peaks of the speech currents will not reduce the ON current below the minimum holding current of the device.

Phasing Unit for Operation of Silicon Controlled Rectifiers

In the circuit shown in Fig. 9 switch S_1 is a relaxation oscillator with a natural frequency slightly less than the supply frequency. The supply is half-wave rectified. The resultant positive pulses developed across the 15-kΩ resistor are added to the instantaneous voltage across the switch. The result is to pull the oscillator into synchronism with the mains frequency.

The positive sawtooth waveform is a.c. coupled to switch S_2. The voltage waveform across S_2 is a sawtooth having a mean value of the applied d.c. voltage set by the potentiometer. As the d.c. voltage is increased (i.e., the lower end of S_2 made more negative), the negative peaks of the waveform raise the voltage across the switch to the trigger voltage, V_T, and the switch bursts into oscillation, Fig. 10.

Progressive increase in applied h.t. voltage advances

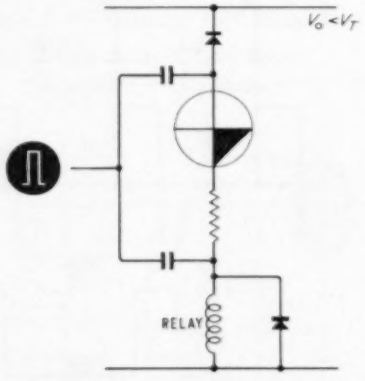

Fig. 13. *A variation of the circuit shown in Fig. 12*

the start of the burst of oscillations. The first positive pulse of the burst is used to fire the controlled rectifier. Thus the timing of the triggering pulse and hence the conduction angle of the rectifier is controlled by the level of the d.c. voltage. Fig. 11 shows the relevant waveforms of the circuit.

Single-Ended Bistable Circuit

The total series resistance in Fig. 12 permits a current in excess of the holding current to flow. The ON pulse adds to the supply voltage V_0, raising the voltage across the switch to V_T, turning the switch ON. The OFF pulse reverse biases the switch reducing the forward current to below I_H and the switch reverts to the high impedance state.

A variation of this circuit is shown in Fig. 13.

The circuit is in the reverse arrangement for positive input pulses and one resistor has been replaced by a relay coil. With the common inputs as shown, successive pulses make and break the relay contacts. The diode in parallel with the relay winding acts as a clipper to remove the inductive overswing of voltage across the coil.

The examples given are but a few of the many applications of this two-state device in timing, control, pulse generation and switching circuits, in which its small physical size, robustness and simplicity of connection can be used to advantage.

REFERENCE

[1] J. E. Flood and W. B. Deller, "The PNPN Diode as a Cross-Point for Electron... Telephone Exchanges", *Proc. Instn elect. Engrs*, Nov. 1960, Part B, Supplement No. 20, Vol. 107, p. 291.

MATHEMATICAL TOOLS — By Computer

Further Applications of the 'Root-Locus' Method

In the last few articles, we have considered the application of the root-locus method to feedback problems where the characteristic equation of the system was not of very high degree. In the present article we seek to show the great usefulness of the root-locus method by applying it to an equation of degree 13; this just shows what can be done with it. Part of the point is to pay a mathematician's grateful tribute to the workers in the field of servomechanisms and control devices for producing this method of locating approximately the roots, and especially the complex roots, of equations.

When a mathematician wishes to solve an equation, there are many iterative methods available (such as that of Lin, which has been discussed for simple cases in this series of articles) so that when a rough approximation to a root is known, a better approximation can be found. In the case of real roots, a rough approximation can be found by drawing a graph, but there is no obvious way of getting a starting approximation, or a general idea of how the roots are arranged, when a pair of complex roots is being sought. The root-locus method provides just this information, and provides it in such a way that all computations are performed on the original equation instead of on a derived equation, for example, one in which roots already found have been factored out. Hence if there is an error in the calculation of a particular

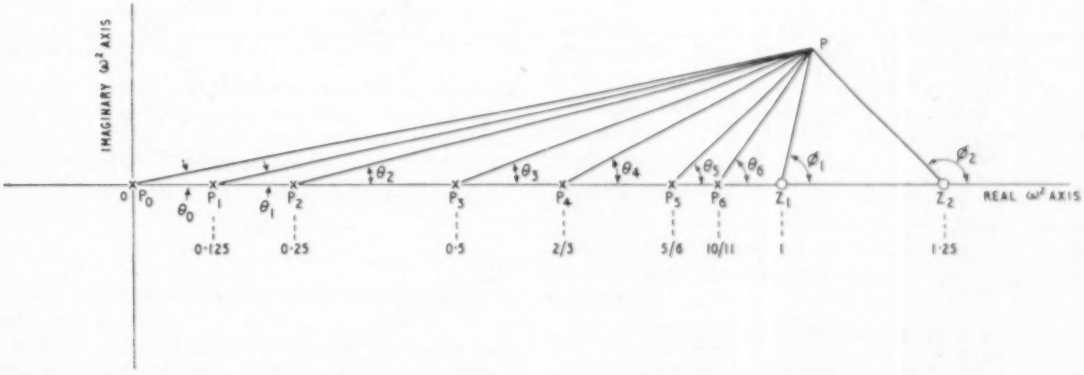

Fig. 1. *Poles and zeros associated with Equs* (1) *and* (2), *together with arbitrary point P.*

root, this will not affect the calculation of any other root.

The equation to be solved arose in connection with a problem of filter design: it was originally written in the form

$$1 + K \frac{(1-\omega^2)^2\,(1-0{\cdot}8\omega^2)^4}{\omega^2(1-8\omega^2)^2\,(1-4\omega^2)^2\,(1-2\omega^2)^2\,(1-1{\cdot}5\omega^2)^2\,(1-1{\cdot}2\omega^2)^2\,(1-1{\cdot}1\omega^2)^2} = 0 \quad .. \quad .. \quad (1)$$

and the case we really wish to consider is when $K = 1$. To take full advantage of the root-locus procedure, however, we shall allow K to have other values also when necessary. Without the root-locus method, Equ. (1) defied the joint efforts of the author and his assistant for several days. With the root-locus method and the straightforward interpolation techniques indicated below, the roots given here were determined in about the same length of time; accuracy achieved is discussed later. Accuracy could have been improved by iterative processes (which would be tedious for an equation of such high degree, though straightforward) but this was considered unnecessary, especially when the practical problem which gave rise to Equ. (1) had lost priority before the roots given here were obtained.

Our object in this article is simply to show what can be done if we have sufficient "mathematical faith". Equ. (1) must first be rearranged so that the coefficient of ω^2 is unity in each factor; we shall regard ω^2 and not ω as the unknown quantity. Equ. (1) thus becomes

$$1 + \frac{K}{39204} \cdot \frac{(1-\omega^2)^2\,(1{\cdot}25-\omega^2)^4}{\omega^2(0{\cdot}125-\omega^2)^2\,(0{\cdot}25-\omega^2)^2\,(0{\cdot}5-\omega^2)^2\,(\tfrac{2}{3}-\omega^2)^2\,(\tfrac{1}{2}-\omega^2)^2\,(\tfrac{1\cdot0}{1\cdot1}-\omega^2)^2} = 0 \quad .. \quad (2)$$

and the arrangement of poles and zeros is thus as in Fig. 1, P being an arbitrary point.

As ω^2 is the unknown quantity being sought, the origin P_0 is a simple pole, $P_1, P_2 \ldots P_6$ are all double poles, Z_1 is a double zero and Z_2 is a quadruple zero. Only the part of the real ω^2-axis to the left of P_0 belongs to the root-locus, for if ω^2 is real and positive, there is always an even number of poles and zeros to the right. As all the poles and zeros except P_0 and Z_2 are double, the root-locus must leave the real axis vertically at the poles P_1 to P_6 and approach it vertically at Z_1. It will cross the real axis at these places, and short vertical lines can be drawn through them as a first step in sketching the root-locus.

At P_0 there is a single pole, and the root-locus leaving P_0 is the negative real axis as already mentioned. At Z_2 there is a quadruple zero, and we must determine next how the root-locus reaches Z_2. An arbitrary point P (see Fig. 1) will be on the root-locus if the sum of the angles formed when P is joined to each pole (counting double poles twice) differs from the sum of the angles formed when P is joined to each zero (counting Z_1 twice and Z_2 four times) by an odd multiple of 180°; in other words, in the notation of Fig. 1, the critical quantity is

$$X = \theta_0 + 2\theta_1 + 2\theta_2 + 2\theta_3 + 2\theta_4 + 2\theta_5 + 2\theta_6 - 2\phi_1 - 4\phi_2 \quad (3)$$

and X must be an odd multiple of 180° for P to be on the root-locus. In Fig. 1 all the angles mentioned are significant, but if P is very close to Z_2, the only angle

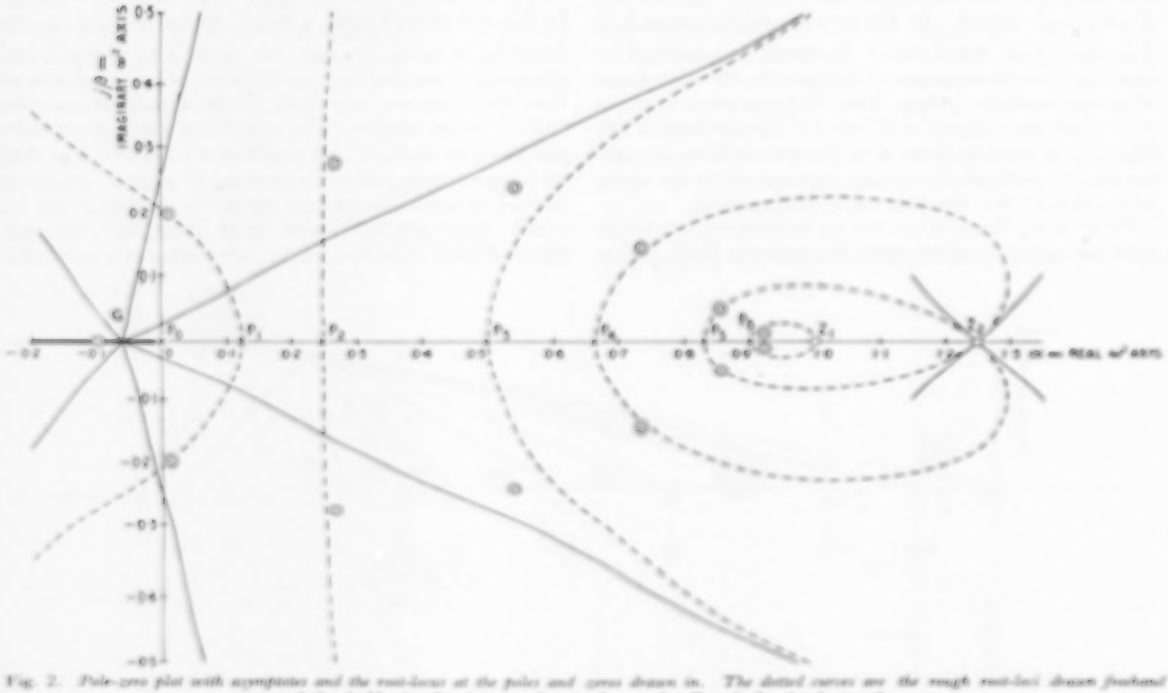

Fig. 2. *Pole-zero plot with asymptotes and the root-locus at the poles and zeros drawn in. The dotted curves are the rough root-loci drawn freehand and the doubly-ringed points are the actual roots for K = 1 found subsequently.*

which differs significantly from zero is ϕ_2, and therefore when P is near Z_2, $4\phi_2$ must be an odd multiple of 180° for P to be on the locus. Hence ϕ_2 must be $\pm 45°$ or $\pm 135°$, and short lines at these angles through Z_2 are included in Fig. 2.

The next step is to draw in the asymptotes from the centre of gravity G. The position of G is obtained by adding together the co-ordinates of all the poles, subtracting those of all the zeros, and dividing by 7, the difference between the number of poles (13) and the number of zeros (6). The co-ordinates of the poles and zeros are clear from Equ. (2), so that the sum of the co-ordinates of the poles is

$$0 + 2\,(0{\cdot}125 + 0{\cdot}25 + 0{\cdot}5 + \tfrac{3}{8} + \tfrac{5}{8} + \tfrac{10}{11}) = 6\tfrac{25}{44}$$

while the sum of the co-ordinates of the zeros is

$$2 \times 1 + 4 \times 1{\cdot}25 = 7$$

The position of G is therefore specified by

$$(6\tfrac{25}{44} - 7) / 7 = -19/308$$

so that G is at $-0{\cdot}0617 + 0j$.

Since there are 13 poles and 6 zeros, the asymptotes, which all pass through G, are in directions θ such that

$$(13 - 6)\,\theta = \text{odd multiple of } 180°$$

so that θ must be $\pm 25\tfrac{5}{7}°$, $\pm 77\tfrac{1}{7}°$, $\pm 128\tfrac{4}{7}°$ or 180°. The asymptotes can therefore be drawn as in Fig. 2; they make angles of $51\tfrac{3}{7}°$ with each other.

We now know that the root-locus consists of the real axis to the left of P_0, branches crossing the real axis at right angles at P_1, P_2, P_3, P_4, P_5, P_6 and Z_1, and that it crosses the real axis twice (at angles $\pm 45°$) at Z_2, and we know the positions of the asymptotes. We can therefore sketch it in roughly. From a pole the locus must terminate on a zero or approach an asymptote, so the most probable form is as in Fig. 2. The loci through P_1 and P_2 are easily sketched, while that joining P_6 to Z_1 and that connecting P_4 and P_5 to Z_2 have a fairly obvious general shape. The branch through P_3 is the most difficult to guess, but we do not need a very accurate guess. Our purpose is to find the roots of Equ. (1) when $K = 1$; this is done by trial and error, and even the rough root-locus of Fig. 2 gives us sufficient guidance as to where to try. The dotted curves have been drawn in freehand by guesswork, guided only by the known crossing points of the real axis and asymptotes. We have anticipated somewhat by plotting the positions of the roots finally obtained in Fig. 2, surrounded by double rings. They are remarkably close to the guessed curves. This shows how informative such easily drawn curves can be.

To obtain further points on the root-locus, we must revert to Fig. 1 and Equ. (3); any point where X is an odd multiple of 180° is on the root-locus and vice versa. At such a point, the corresponding value of K is given by

$$K = 39204\,\frac{PP_0 \cdot PP_1^2 \cdot PP_2^2 \cdot PP_3^2 \cdot PP_4^2 \cdot PP_5^2 \cdot PP_6^2}{PZ_1^2 \cdot PZ_2^4} \qquad \ldots\ \ldots\ (4)$$

where PP_0, etc., are the lengths of the lines joining P to the poles and zeros.

To achieve our ultimate objective of finding a root where $K = 1$, we start with a trial point Q_1 as in Fig. 3 which appears to be suitable from the general lie of the

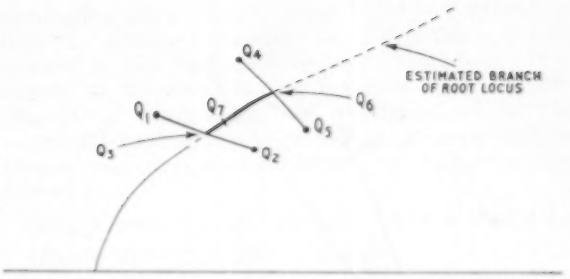

Fig. 3. *Systematic determination of points on the root-locus, and roots of Equ.* (2).

appropriate branch of the root-locus. For Q_1 we compute the value of X, say X_1, from Equ. (3). If it is not widely out, we take another point Q_2, near Q_1, and determine the corresponding value X_2 of X. By interpolation we can deduce a third point Q_3 which will usually be very close indeed to the root-locus. For this point we can find the corresponding value K_3 of K from Equ. (4). By repeating the process with a neighbouring pair of points Q_4 and Q_5, we can determine a second interpolated point Q_6 which should again be very close to the root-locus. If K_6 is the value of K associated with Q_6, we can do a further interpolation to find the wanted point Q_7, which is not only on the root-locus but has $K = 1$ and therefore determines a root of Equ. (2). This procedure we now apply in simplified form to determining the real root, and we also give in detail the determination of the root of Equ. (2) on the branch of the root-locus through P_1.

Unless the root-locus is drawn on a very large scale, no great accuracy can be obtained geometrically, and it is usually best to compute the relevant angles and lengths. If P is at $\alpha + j\beta$, we have

$$\tan\theta_2 = \frac{\beta}{\alpha - 0{\cdot}25}\ ;\ PP_2^2 = (\alpha - 0{\cdot}25)^2 + \beta^2 \qquad (5)$$

with similar equations for the other poles and zeros.

If we seek first the root for which ω^2 is real and negative, we do not have to consider the value of X which is automatically 180°, so that in effect in Fig. 3 we have only to determine Q_3 and Q_6 and the interpolation of the wanted point Q_7 from them. If Q_3 is at $-0{\cdot}1 + 0j$, then $Q_3P_0 = 0{\cdot}1$, $Q_3P_1 = 0{\cdot}225$, $Q_3P_2 = 0{\cdot}35$, $Q_3P_3 = 0{\cdot}6$, $Q_3P_4 = 0{\cdot}767$, $Q_3P_5 = 0{\cdot}933$, $Q_3P_6 = 1{\cdot}009$, $Q_3Z_1 = 1{\cdot}1$ and $Q_3Z_2 = 1{\cdot}35$; substitution of these values in Equ. (4) gives $K_3 = 1{\cdot}135$. This is not far from the required value of unity, so we try Q_6 at $-0{\cdot}09 + 0j$ and find, from Equ. (4), that $K_6 = 0{\cdot}840$.

We now find the position of Q_7, where $K = 1$, by interpolation. This means that we suppose, in this neighbourhood,

$$\log K = x\,\alpha + y \qquad \ldots\ \ldots\ \ldots\ \ldots\ (6)$$

where $-\alpha + 0j$ is the position of any point P between Q_3 at $-0{\cdot}1 + 0j$ and Q_6 at $-0{\cdot}09 + 0j$, and x and y are constants obtained by solving the simultaneous equations

$$\log K_3 = 0{\cdot}05520 = -0{\cdot}1\,x + y$$

$$\log K_6 = \bar{1}{\cdot}92453 = -0{\cdot}09\,x + y$$

so that $x = -13{\cdot}067$ and $y = -1{\cdot}2515$. (The values of

Fig. 4. *Illustrating the behaviour of log PP_2 as P moves between Q_3 and Q_5.*

log K given were obtained by working to five-figure accuracy, but this is in general an unnecessary refinement.) Since log 1 is zero, the required value of x at Q_7 is $-y/x$ or $-0{\cdot}0958$. This value can be checked by direct substitution for K in Equ. (4) and if necessary the value of K obtained could be used for further interpolation.

It may be asked why in Equ. (6) we assumed that log K rather than K varied linearly with x. The explanation is that Equ. (2) involves many multiple poles and zeros. If we seek a point on the root-locus which is very near P_2, say, then Equ. (4) shows that for arbitrary variations of P near P_2, K is approximately proportional to PP_2^2, since the other distances like PP_0, PP_1, PZ_1 will not differ significantly from P_2P_0, P_2P_1, P_2Z_1, etc., and can therefore be regarded as sensibly constant. Thus the relation between K and PP_2 is non-linear, whereas log K is 2 log PP_2 plus a constant, in other words, log K is linearly related to log PP_2. In Fig. 4, P is shown at an arbitrary point between Q_3 and Q_5. If Q_3Q_5 makes an angle ϕ with P_2Q_3 as indicated, and Q_3Q_5 is small compared to Q_3P_2, then PP_2 is approximately equal to $P_2Q_3 + PQ_3 \cos\phi$, and therefore

$$\log_e PP_2 = \log_e Q_3P_2 + \log_e\left(1 + \frac{PQ_3}{P_2Q_3}\cos\phi\right)$$

$$\approx \log_e Q_3P_2 + \frac{PQ_3}{P_2Q_3}\cos\phi$$

so that $\log_e PP_2$, or $\log_{10} PP_2$, is, in general, linearly related to PQ_3 as P moves along Q_3Q_5. If we seek a root which is not near a multiple pole or zero, much the same result will be obtained whether we use linear interpolation with respect to log K as suggested above, or with respect to K in the ordinary way. It is easier to have the same rule for all cases, since we have no means of telling in advance how near the poles and zeros the various roots of Equ. (2) are going to be. We have therefore interpolated logarithmically in all cases; the above argument is clearly unaffected if we are looking for a complex root instead of a real negative one as here.

For the root of Equ. (2) on the branch through P_1 and above the real axis, we try Q_1 (in the notation of Fig. 3) on the imaginary axis at $0 + 0{\cdot}2j$. The corresponding value of X_1 is $-173° 8'$. Q_2 can therefore usefully be taken at $0 + 0{\cdot}21j$ and the corresponding value X_2 of X is $-181° 44'$. It happened to be convenient in this case to make Q_1Q_2 parallel to the imaginary ω^2-axis, but this need not be done; Q_1Q_2 can be in any direction, and in general it is useful to have it approximately normal to the estimated root-locus. We now determine the interpolated point Q_3 on the root-locus by assuming that the value of X at any point Q on the line Q_1Q_2 varies linearly with QQ_1; in other words, we assume that at the point Q whose co-ordinates are $\alpha + j\beta$ where

$$\alpha + j\beta = k\,(0 + 0{\cdot}2j) + (1 - k)\,(0 + 0{\cdot}21j) \quad .. \quad (7)$$

the value of X is given by

$$X = k\,(-173° 8') + (1 - k)\,(-181° 44') \quad .. \quad (8)$$

and since we want X in Equ. (8) to be $-180°$, we can find k uniquely. Obviously

$$-180° = k\,(-180°) + (1 - k)\,(-180°) \quad .. \quad (9)$$

and if we subtract Equ. (9) from Equ. (8) with X on the left-hand side replaced by $180°$,

$$0 = k(6° 52') - (1 - k)\,(1° 44')$$

Working in minutes, this gives

$$412k - 104(1 - k) = 0, \text{ or } k = \frac{104}{516} = 0{\cdot}2016$$

The position of Q_3 is thus obtained by substituting this value for k in the expression for $\alpha + \beta j$ in Equ. (7). α is clearly zero and β is 0·2080, but Equ. (7) has been written as above so that this interpolation process can easily be applied when Q_1Q_2 is in any direction. We here take Q_3 as being on the root locus; if necessary the value X_3 of X at Q_3 could be checked by substitution in Equ. (3) and the interpolation process repeated.

Next, the value K_3 of K at Q_3 is obtained from Equ. (4) and found to be 1·535; as this is above unity, the point Q_4 in Fig. 3 should for this case be taken nearer P_1 (where $K = 0$) so we take Q_4 at $0{\cdot}02 + 0{\cdot}18j$, guessing the $0{\cdot}18j$ from the general lie of the estimated curve of Fig. 2. X_4 is then $-177° 52'$, so Q_5 was taken as $0{\cdot}02 + 0{\cdot}182j$ and X_5 was found to be $-179° 38'$. This was considered at the time accurate enough, so Q_5 was regarded as Q_6; a better position for Q_6 would have been $0{\cdot}02 + 0{\cdot}1824j$. If Q_6 is taken as $0{\cdot}02 + 0{\cdot}182j$, K_6, from Equ. (4) is 0·7812.

Once again, we assume that if Q′ (with co-ordinates $\gamma + j\delta$) is any point on the line Q_3Q_6, log K varies linearly with $Q'Q_3$; we also assume that the short chord Q_3Q_6 of the root locus is indistinguishable from the locus itself. This means that we take the value of K at Q′ where

$$\gamma + j\delta = k'(0 + 0{\cdot}2080j) + (1 - k')\,(0{\cdot}02 + 0{\cdot}182j) \quad .. \quad .. \quad (10)$$

to be given by

$$\log K = k' \log 1{\cdot}535 + (1 - k') \log 0{\cdot}7812 \quad .. \quad (11)$$

so that at Q_3, where $K = 1$ and $\log K = 0$, we have

$$k' = \frac{-\log 0{\cdot}7812}{\log 1{\cdot}535 - \log 0{\cdot}7812} = \frac{0{\cdot}10725}{0{\cdot}29334} = 0{\cdot}3655$$

Thus we finally obtain the root of Equ. (2) on the

branch through P_1 of the root-locus by substituting the value 0·3655 for k' in Equ. (10); it is 0·0127 + 0·1915j. This was regarded as sufficiently accurate.

The roots of Equ. (2) associated with the remaining branches of Fig. 2 were determined in like manner; one set of points Q_1-Q_7 was considered sufficient to enable each root of Equ. (2) to be determined, and these roots, plotted on Fig. 2 surrounded by double circles, could have been used to improve our estimate of the root-locus as a whole. This, however, is not worth doing unless we are interested in several different values of K: the crude estimate of Fig. 2 is, as we have seen, obtainable quickly and is all that is needed. For the root near 0·92, advantage was taken of the fact that θ_6 is much more sensitive to small changes in the position of the trial point P (necessarily near P_6) than any other angle. The collected values of ω^2 for the roots of Equ. (2) thus obtained are:

$-0{\cdot}0958$; $0{\cdot}0127 \pm 0{\cdot}1915j$; $0{\cdot}2679 \pm 0{\cdot}2746j$;
$0{\cdot}5427 \pm 0{\cdot}2359j$; $0{\cdot}7366 \pm 0{\cdot}1363j$; $0{\cdot}8565 \pm 0{\cdot}0513j$;
$0{\cdot}9230 \pm 0{\cdot}0160j$.

and it now remains to discuss the overall accuracy achieved.

For the particular root-pair $0{\cdot}5427 \pm 0{\cdot}2359j$, Equ. (1) was cleared of fractions (with $K = 1$) and the left-hand side was then divided by the corresponding quadratic factor in ω^2, namely $\omega^4 - 1{\cdot}0854\omega^2 + 0{\cdot}35017$, with the astonishing result that this root-pair checked to four significant figures! When Equ. (1) is cleared of fractions, the number-term is 1, the coefficient of ω^2 is $-4{\cdot}2$, the coefficient of ω^{24} is $-105{,}471{\cdot}5904$ and the coefficient of ω^{26} is $16057{\cdot}9584$ Overall accuracy is thus checked by evaluating the following:

Sum of roots (in ω^2) is 6·5832, when it should be $105{,}471{\cdot}5904/16057{\cdot}9584 = 6{\cdot}5681$

Product of roots is $-6{\cdot}3903 \times 10^{-5}$, when it should be $-1/16057{\cdot}9584 = -6{\cdot}2274 \times 10^{-5}$

Sum of reciprocals of roots is 4·128, when it should be 4·2/1 or 4·2.

Now in the evaluation of the sum of reciprocals of the roots, the result 4·128 arises as the difference between the negative reciprocal of $-0{\cdot}0958$ and the positive reciprocals associated with the remaining roots, an error in the first place of decimals is therefore not surprising.

Thus we contend that it is not at all necessary for an engineer to be frightened when he sees a cubic or quartic equation, as the equation of degree 13 here considered has been solved by means of processes (notably that illustrated in Fig. 3) which are within the capacity of any competent engineer.

AUTOMATIC PRINTED CIRCUIT DRILL

A fully automatic printed circuit drill, which has been designed for fast and economical drilling of component fixing holes in printed circuit boards, has been introduced by Ferranti. This new machine, already in limited quantity production at the Company's Edinburgh factory, will cost £3,600.

Basically, the machine consists of two drilling heads allowing either tandem or single spindle working; a hydraulically-operated co-ordinate table carrying the printed circuit boards which is automatically moved to bring the board hole centres in turn below the drills; and a control system for the drilling action and table movement which enables the machine to work unattended except for loading and unloading.

The drilling table, which covers an area of 20 in. by 18 in. is moved parallel with or at right angles to the front of the machine by two hydraulic jacks. Accurate positioning of hole centres under the drills is carried out in two contiguous stages. First, rough positioning is achieved by the use of a perforated plate and a photo-electric cell. Secondly, accurate positioning is obtained by a mechanical indexing system using the meshing of a ball nut and precision rack. A positional accuracy of ±0·001 in. can be obtained and repeatability is within 0·001 in.

Drilling is carried out to a grid system, the holes being drilled in a symmetric pattern of rows and columns. The basic spacing between rows of the grid system is determined by the pitch of the thread of the rack associated with row alignment, a typical pitch is 20 threads per inch. A similar rack is used for column alignment.

A perforated template is mounted on an extension of the drilling table and wherever a hole in the drilling area coincides with the light beam the photo-electric cell is simulated and provides a signal to the machine's control system.

The machine can accommodate a single stack (up to 2 in. deep) of one or more printed circuit boards with dimensions of up to 9½ in. by 10 in. with maximum drilling dimensions per board of 9½ in. by 7½ in.

The unit of output data, of course, depend on the pattern of holes to be drilled and the number and thickness of boards forming the stack. But in a typical case two stacks of four boards of 5½ in. by 7½ in. by $\frac{1}{16}$ in. requiring 288 holes per board, are completely holed in 14½ min.; i.e. an average time of 108 sec per board.

The illustration shows a drilled printed circuit board alongside the printed circuit automatic drill

Rectifier Modulators

EFFECT OF STRAY CAPACITANCE AND TUNING

By J. A. Richardson,* M.Sc., and D. G. Tucker,† D.Sc.

SUMMARY. *It is shown that stray capacitances in rectifier modulators of nominally purely-resistive type always increase the conversion loss. Sets of experimental results and some theory are discussed. The capacitances can be tuned-out by inductors connected across the modulator terminals, and it is shown that it does most frequently pay to do this. However, when the resistance terminations of the modulator are high compared with the forward resistance of the rectifiers the conversion loss may be greatly increased by tuning.*

The behaviour of rectifier modulators is very complex and its calculation usually very difficult in all but some simplified cases[1]. The design of such modulators is therefore full of pitfalls, and must be undertaken with care. A rather interesting and important example of this is the effect of stray capacitances. As will be shown, these always increase the conversion loss‡ of the modulator, and it is therefore tempting to think that if they are tuned-out by means of inductors connected in parallel, the loss of the modulator will be restored. Unfortunately, this is not always true. Only too often the loss will be greatly increased. The explanation of this in physical terms is difficult, but is connected with the fact that when the capacitance is relatively large, the tuning virtually short-circuits unwanted frequency components at each end, and makes the modulator efficient only when the terminating resistances at the wanted frequencies are very low, of the order of the forward resistance of the rectifiers. The design of the modulator involves, therefore, not only the decision of whether to tune or not, but also the choice of rectifiers with a forward resistance of the correct value for the circuit.

The analysis of the performance of modulators with stray capacitances is not conveniently effected (even if possible at all) by the usual formal methods, but a special analysis of this problem was published by Belevitch[5] using a direct approach. The switching effect of the square-wave carrier was regarded as giving a series of repeated transients, and a general formula for conversion loss, together with a number of approximate formulae for the case of 'ideal' rectifiers, were given. The reasoning given in the paper was perfectly clear, but unfortunately the mathematical expressions contained so many misprints that the paper is difficult to use. It has consequently been thought desirable to include a corrected version of the formulae with some additional commentary by the present authors as Appendix 3 of the present paper. Two other papers[4,6] by Belevitch are also relevant. It is shown in Appendix 3 that his formulae give results in agreement with measurement. But the calculation of losses for a range of conditions is prohibitively laborious since the formulae are, in general, rather complex. It was consequently decided to make an experimental investigation of the matter.

This paper describes an experimental investigation of modulators with stray capacitance on a low-frequency basis, the effect of stray capacitance at high frequencies being simulated by the connection of large capacitances across the modulator terminals. To avoid giving the impression of complete generality, the actual measured results will be given for the specific conditions of test; but it will then be shown that some normalization, or generalization, is possible.

The Experimental Results for Shunt Capacitance

The experimental arrangements are shown in Fig. 1 and described more fully in Appendix 1. The carrier, or switching-signal, was a square wave§ with a fundamental frequency of 1,970 c/s, and the signal frequency

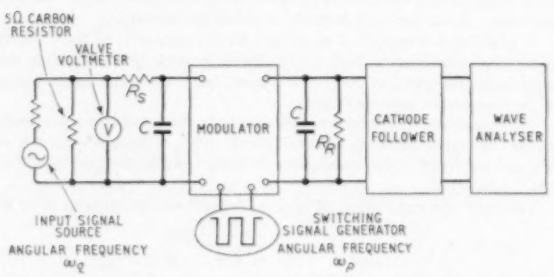

Fig. 1. *Test Circuit*

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† *Electrical Engineering Department, University of Birmingham.*

‡ Conversion loss is defined as $20 \log_{10} A$ dB, where A is the ratio of the output voltage across the load resistance (R_R in Fig. 1), when the modulator (and its stray capacitances) are removed, to the output voltage across the same resistance, at the wanted sideband frequency when the circuit is complete.

§ The use of some waveform other than square will not alter the nature of the results, but will increase the losses by a small amount.

was 100 c/s, except in an additional set of measurements with the ring modulator in which it was made 700 c/s. The modulator circuits used are shown in Figs. 2, 3 and 4. R_G and R_R are the sending- and receiving-end resistance terminations, and C is the capacitance added equally at both input and output terminals. In all tests, $R_G = R_R$. The wanted sideband is taken as signal frequency plus carrier frequency.

The results obtained are shown in Figs. 5, 6 and 7 for the series, shunt and ring modulators, respectively. It should be noted from Appendix 1 that the forward resistance of the rectifiers was 70, 90 and 650 Ω in the three cases respectively. It can be seen that the capacitance always increases the conversion loss, and that as the capacitance is increased the value of the minimum conversion loss increases while the terminating resistance value at which it occurs decreases. It is also evident that the minimum conversion loss is more closely defined with high capacitance and therefore design will be more critical.

Normalization of the Results

It is possible to present the results in a normalized form which will make their application to practical design work much easier. If it can be assumed that the

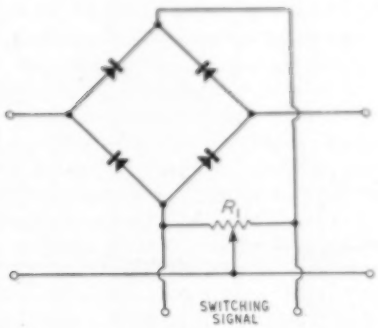

Fig. 2. *Series Modulator*

ratio of back resistance r_b to forward resistance r_f of the rectifiers is very large (as it is in all common types of rectifier except copper-oxide used at high frequencies[2]), then for the range of results where the terminating resistance R is below the geometric mean $\sqrt{r_b r_f}$, it is reasonable to expect the normalized quantity R/r_f to form a suitable abscissa scale; above this range, R/r_b should be satisfactory. The capacitance can be normalized with respect to both frequency and rectifier resistance by plotting the curves with X/r_f or X/r_b as a parameter in the two ranges respectively; X is taken as the reactance of the capacitance at the carrier frequency. The results should then apply fairly accurately whenever the input signal frequency is small compared with the carrier, with an increasing error as the input frequency is increased. Further error will, of course, arise at frequencies high enough to make the simple representation of the stray capacitance inadequate.

With these scales, the graphs should be plotted in terms of the single-loop equivalent circuit of all three

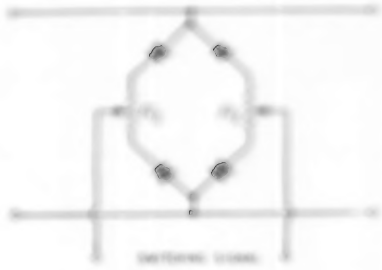

Fig. 3. *Shunt Modulator*

types of modulator, as discussed fully in Ref. 1 for a square-wave carrier, and more generally but more briefly in Ref. 3. This circuit is shown with R and X separated in Fig. 8. For the series modulator,

$$R = R_S + R_R;\ X = 2/\omega_p C \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

For the shunt modulator,

$$R = \frac{R_S R_R}{R_S + R_R};\ X = 1/2\omega_p C \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

For the ring modulator,

$$R = R_S = R_R;\ X = 1/\omega_p C; \quad \ldots \quad \ldots \quad \ldots \quad (3)$$

but with the particular circuit of Fig. 4, as used in the tests, the resistors used to feed the carrier to the lattice (thus avoiding the use of a transformer, which would have complicated the reactance) must be regarded as part of R_S and R_R. Another complication with the ring modulator is that since the input and output circuits are physically separated by a bridge circuit, the input current does not also flow in the output termination as it does in the series and shunt modulators, nor does the output current flow in the source impedance. This is why the conversion loss is 6-dB less for the ring than for the others when the circuits are purely resistive. It therefore seems reasonable to raise all the ring modulator curves by 6 dB in order to normalize them. This might be expected to be less effective for higher losses.

With all these adjustments, the graphs of Figs. 9 and 10 result. (The ranges of the two figures have been allowed to overlap.) It can be seen that all the measured results now fit into a single pattern with reasonable consistency, especially considering the widely different values of r_f in the three modulators used. It is clear that the 6-dB lift of the ring modulator curves

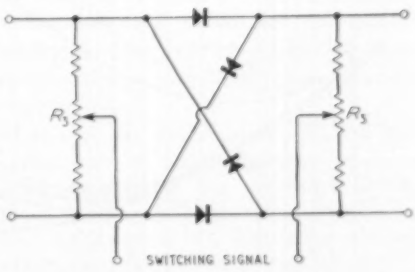

Fig. 4. *Ring Modulator*

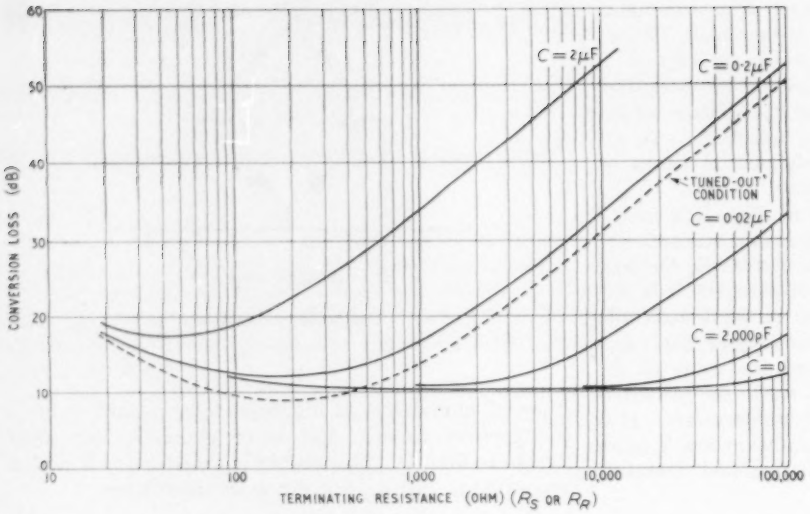

Fig. 5. *Series Modulator. Conversion loss v. terminating resistance for various capacitance values*

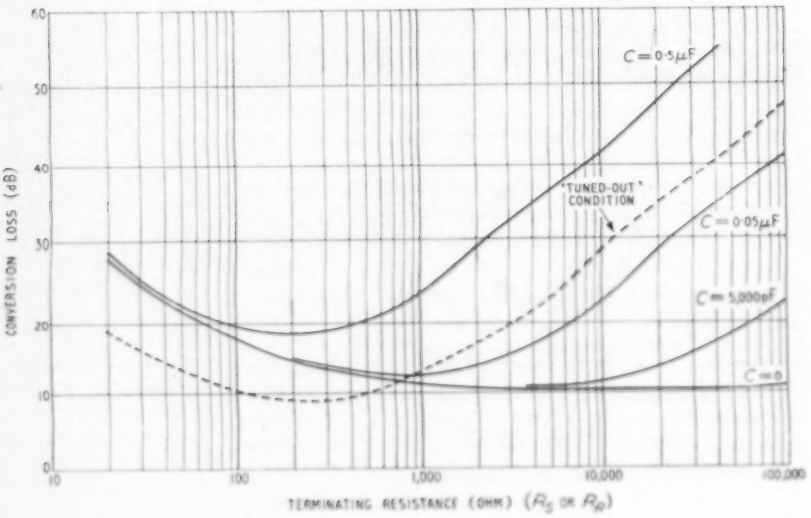

Fig. 6. *Shunt Modulator. Conversion loss v. terminating resistance for various capacitance values*

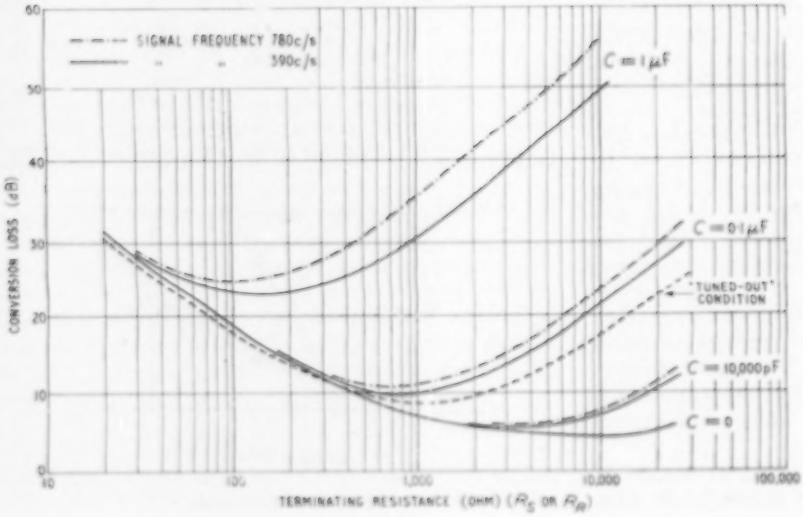

Fig. 7. *Ring Modulator. Conversion loss v. terminating resistance for various capacitance values*

is necessary as well as reasonable for the lower loss values; but at high losses, where X is very small compared with R, the reasoning breaks down, and better consistency is obtained if the 6-dB adjustment is not made. This can be seen clearly in the upper group of curves in Fig. 10.

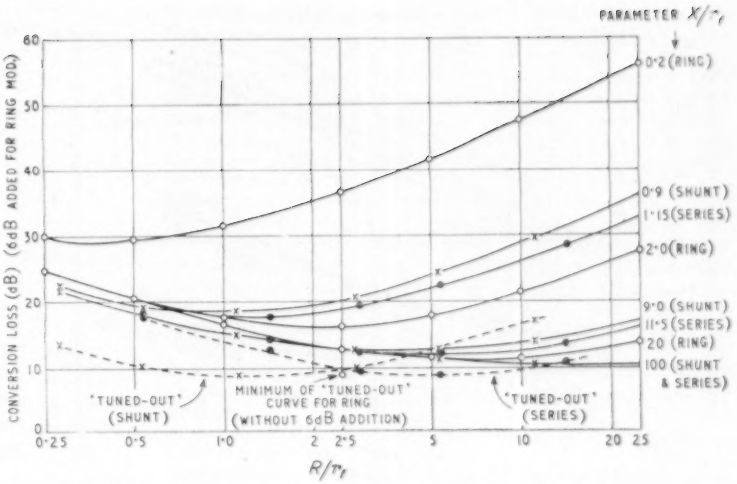

Fig. 9. *Measured conversion loss curves normalized with respect to forward resistance*

Dependence of Conversion Loss on Time-Constant

It can be seen by inspection of the curves of Figs. 5 and 6 that on the right-hand side the conversion loss tends to be constant for a constant product RC. A plot of conversion loss against RC is given in Fig. 11 for all three types of modulator over the whole range of all curves. The full line has been drawn only by visual estimate of the trend. It is found that

(a) the ring modulator does not fit the general picture so closely as the others, with or without a 6-dB adjustment.

(b) it is only at time-constants above the period of the carrier cycle that complete consistency is obtained for the series and shunt modulators.

(c) consistency is obtained at the lower time-constants for the series and shunt modulators if points derived from measurements made at or to the left of the minima in Figs. 5 and 6 are excluded.

That a relationship of this kind is to be expected is clear from Belevitch's formula, given in Appendix 3, Equ. (11), but this formula assumes $\omega_q = 0$, whereas for the measurements, $\omega_q/\omega_p = 0{\cdot}2$. It is, however, valuable to check the full formula Equ. (7) against the curve of Fig. 11 for large RC values. Take, for example, $RC = 2{\cdot}5 \times 10^{-3}$ sec. Then from Equ. (7) the conversion loss is 9·9 + 21·8 + 37·4 − 28·1 dB; i.e., 41·0 dB. Fig. 11 shows the loss as 36·7 dB, so that there is a considerable discrepancy; nevertheless, with such large losses it has little practical significance.

The effect of a change of input signal frequency is interesting and from Equ. (7) we know it will be a complicated effect. Calculation shows that for $\omega_q = 0$, the loss at $RC = 2{\cdot}5 \times 10^{-3}$ sec would be 40·4 dB, and for $\omega_q/\omega_p = 0{\cdot}4$ (i.e., signal = 780 c/s) the loss would be 41·7 dB. It is thus clear that the effect of frequency is very small, in spite of the large variation in the individual factors of Equ. (7). For the ring modulator, the dot-dash curves in Fig. 7, corresponding to 780 c/s input, give general support to this conclusion.

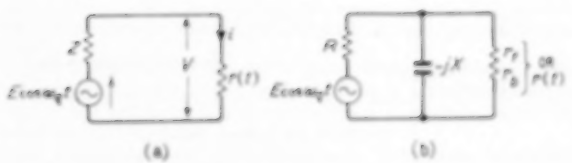

Fig. 8. *(a) Single-loop equivalent circuit of all three modulator types; (b) Equivalent circuit showing R and X*

Assessment of the Circumstances in which it is desirable to tune out the Stray Capacitances by means of Inductance

It will be assumed that the added reactance is always such as to tune the input side to ω_q and the output side to $\omega_p + \omega_q$.

The assessment is made very difficult to generalize because of the following considerations:

(a) The formula for conversion loss of the tuned-out modulators, assuming the tuned circuits give a virtual short-circuit at all modulation-product frequencies except ω_q in the input and $\omega_p + \omega_q$ in the output, is derived in Appendix 2, and is, in all likely practical conditions,

$$\text{Conversion loss ratio} = \frac{\pi}{2}\left(0{\cdot}15\frac{R}{r_f} + 1 + \frac{r_f}{R}\right) \quad (4)$$

This makes it clear that the tuned-out loss is a function of R/r_f, and in fact the optimum condition is $R = 2{\cdot}6r_f$ giving a conversion loss of about 8·9 dB. But in the original, untuned condition, the loss of the modulators is dependent on both r_f and r_b, and in the absence of C the optimum condition is $R = \sqrt{r_b r_f}$, giving a conversion loss of about 9·9 dB for series and shunt modulators and 3·9 dB for the ring, with an additional loss of $17{\cdot}4\sqrt{r_f/r_b}$ dB due to the rectifier dissipation. Thus the comparison cannot be normalized.

(b) Only with the larger values of C will the parallel connection of an inductance really give an approximation to the condition above; i.e., a short circuit at all unwanted frequencies. With very small values of C the tuning-out will merely neutralize the reactance over all the important range of frequencies, leaving the conversion loss

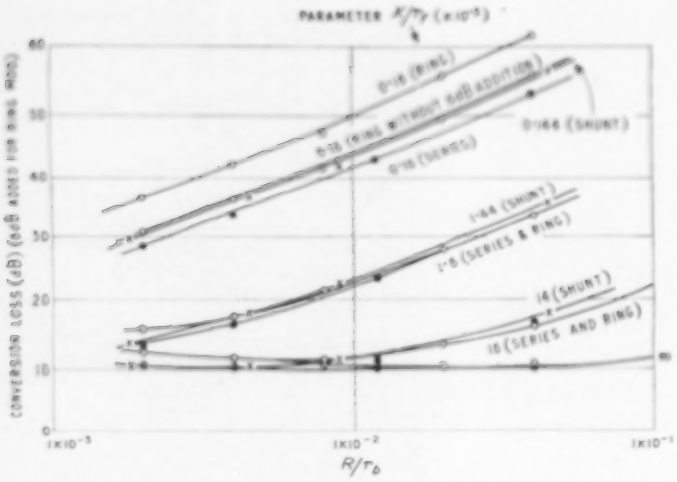

Fig. 10. *Measured conversion loss curves normalized with respect to back resistance*

as given by the non-reactive condition, the formula[2] for which is

$$\text{Conversion loss ratio} = \pi \cdot \frac{n^2 - 1}{(1+mn)(1+n/m)} \qquad (5)$$

where $m = R/\sqrt{r_b r_f}$ and $n = \sqrt{r_b/r_f}$. Equ. (5) applies for the series and shunt modulators; for the ring the ratio is divided by 2. For intermediate values of C, the loss will be very difficult to calculate, but may be expected to lie between the two extreme conditions.

It is possible, however, in spite of these difficulties, to draw some general conclusions, and the loss curves for the tuned-out condition according to Equ. (4) have been added to Figs. 5, 6 and 7 to assist the assessment:

(i) For the series and shunt modulators, the MINIMUM conversion loss when tuned-out to meet the condition of short-circuit at unwanted frequencies is smaller than the MINIMUM loss in any capacitive or non-reactive condition. If, therefore, the designer has a free choice of R, or has a choice of rectifier resistance, it would pay to tune-out, augmenting the capacitance if necessary to make the tuning sharper so as to meet the short-circuit condition. This conclusion does not apply to the ring modulator.

(ii) If tuning to meet the short-circuit condition is not feasible, but the value of C is so low as to give a virtually non-reactive modulator when tuned, then it will always pay to tune all three types of modulator whether there is a free choice of termination or not.

(iii) In the region of $R \triangleq r_f$, it will always pay to tune-out series and shunt modulators, whatever the value of C, but it will pay best to achieve the short-circuit condition if possible. It will pay to tune the ring modulator, too, but the short-circuit condition gives no special advantage in this case.

(iv) In the region $R \gg r_f$, with RC very much greater than the period of the carrier, then tuning-out will necessarily be selective, approaching the short-circuit condition. But in this range the conversion loss when tuned is very high ($\triangleq 20 \log_{10} R/4r_f$), and it will pay to tune only if C is very large. If C is not so large, it will pay NOT to tune.

It can thus be seen that it will most frequently be worth while to tune-out stray (or other) capacitance, but that at high values of R tuning can increase the conversion loss by extremely large amounts.

The normalized curves of Figs. 9 and 10 can be used in the above assessment, but, as previously pointed out, the conversion loss of the tuned modulators can, by the nature of the formula, be normalized only in terms of R/r_f and not R/r_b. The 'tuned-out' curves are therefore shown only in Fig. 9. A separate curve is needed for each type of modulator, since the normalization with respect of R_S and R_R is different from that which had to be used for the non-tuned case. The tuned-out curve for the ring modulator is not drawn in, as the diagram is already sufficiently complicated; but the minimum point (without the 6-dB addition) is shown.

A special note is required regarding the tuning of the shunt modulator. In this circuit, it is useless to present zero impedance at the input for all frequencies other than ω_q and at the output for all frequencies other than $\omega_p + \omega_q$, since the modulator would then have a short circuit across its signal path for all frequencies. It is therefore necessary to aim at some condition such as the following

Source: R_S for frequency ω_q, infinite for frequency $\omega_p + \omega_q$, and any value for other frequencies.

Load: R_R for frequency $\omega_p + \omega_q$, infinite for frequency ω_q, zero for all other frequencies.

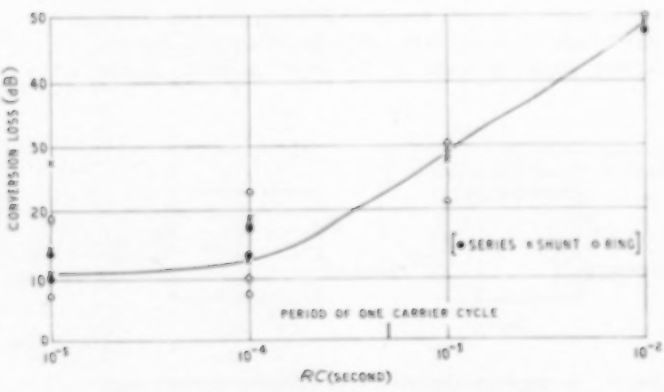

Fig. 11. *Conversion loss measurements as a function of RC*

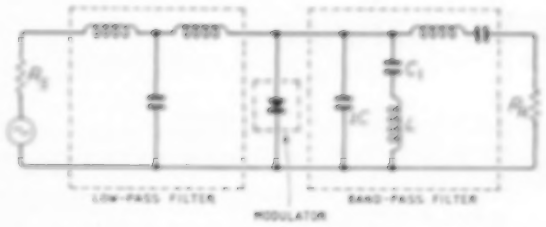

Fig. 12. Tuning of stray capacitance in shunt modulator. (Modulator itself shown symbolically)

This can be approximated[2] by the circuit shown in Fig. 12, where $2C$ = stray capacitance, and C_1 = capacitance to meet the requirement that the output circuit shall have infinite impedance at ω_q. The combination LC_1 resonates somewhere between ω_q and $\omega_p + \omega_q$. This is then the 'tuned-out' arrangement for the shunt modulator when the 'short-circuit condition' is imposed.

A practical matter concerning series and ring modulators requires to be mentioned: it is that when the input signal frequency ω_q is very low compared with the carrier ω_p, then (a) it may be quite unnecessary to tune out the input side, since the reactance at ω_q is probably nearly infinite, yet at the next highest frequency $\omega_p - \omega_q$ it may be relatively near to zero if the capacitance is fairly large; and (b) it may not be possible to tune to one sideband while providing a nearly-zero impedance at the other since the two frequences are so close together; then either the capacitance may be artificially increased to sharpen the tuning, or the tuning may be flattened to cover both sidebands. When the latter is done, the minimum conversion loss[2] is reduced to 7·1 dB occurring when $R = 4{\cdot}5\ r_f$.

Acknowledgements

The authors are grateful to their colleagues Mr. J. M. Layton and Mr. D. P. Howson for many valuable discussions and suggestions.

APPENDIX 1

Experimental Details

TEST CIRCUIT—The circuit was as shown in Fig. 1.

CARRIER SOURCE—This consisted of a transistor oscillator of 1970 c/s followed by a squaring circuit, and generated a satisfactory square wave. An adjustment was provided for the mark-space ratio of the output waveform. The transistors were fed from a battery supply so that the carrier circuitry was isolated from the signal path. The transistor supply voltage was adjustable and a voltmeter was provided for monitoring purposes.

INPUT SIGNAL SOURCE—This was a low-frequency oscillator normally set to 390 c/s, with a low-value carbon resistor arranged to produce an effective source resistance low compared with the termination used.

The output at the first-order upper sideband frequency was measured across the output termination by a waveform analyser, and it was found possible to estimate to 0·1 dB on the scale for readings less than 60 dB.

A battery-operated cathode-follower stage was interposed between the output termination and the analyser in order to increase the effective impedance presented to the modulator, the input impedance of the analyser being 100 kΩ.

All terminating resistors were carbon types matched on a bridge.

THE MODULATOR ARRANGEMENTS—Figs. 2, 3, 4—were made up from four germanium point-contact type rectifiers GEX.34. The rectifiers were selected for similar forward and reverse a.c. characteristics. In each case the modulator was arranged to have minimum crosstalk and stray capacitance across the arms. Carrier balance was obtained by resistors R_c, R_s and R_r. In the case of the ring modulator, some preliminary tests using transformers at input and output revealed that there were factors influencing conversion loss that were difficult to assess, and therefore it was thought preferable to use a centre-tapped resistance feed for the switching signal and to calculate the effective termination values taking the feed resistors into account. The magnitude of the switching signal at the rectifiers was very much reduced compared with the shunt and series cases as a result of the high value feed resistors required.

In all cases the switching signal applied to the rectifiers was made very much greater in amplitude than the input signal so that the production of non-linear effects due to overloading was avoided. This was checked by varying the input signal ± 6 dB from the normal value and observing that no change in conversion loss resulted.

DATA FOR THE THREE MODULATORS

	Series	Shunt	Ring
Peak to peak voltage across rectifier bridge (V) forward	1·5	1·6	0·19
Peak to peak voltage across rectifier bridge (V) reverse	5·0	5·0	
Forward a.c. resistance of rectifiers (Ω)	70	90	400
Back a.c. resistance (kΩ)	500	560	500
Input signal voltage (mV r.m.s.)	40	40	5

APPENDIX 2

Conversion Loss of Tuned Modulator

In the circuit of Fig. 8 (a), $Z = R$ at ω_q and $\omega_p + \omega_q$, but is zero at all other frequencies. Thus $V = 0$ at all frequencies but ω_q and $\omega_p + \omega_q$, where it is V_0 and V_{1+} respectively. Put $G = 1/R$.

Let $$g(t) = \frac{1}{r(t)} = g_0 + g_1 \cos \omega_p t + \ldots\ldots\ldots$$

Then, at frequency ω_q, $V_0 g_0 + \frac{1}{2} V_{1+} g_1 = (E - V_0)G$, and at frequency $\omega_p + \omega_q$, $\frac{1}{2} V_0 g_1 + V_{1+} g_0 = V_{1+} G$

$$\text{Thus } V_{1+} = \frac{-\frac{1}{2} G g_1 E}{(g_0 + G)^2 - \frac{1}{4} g_1^2}$$

$$\text{and conversion loss ratio} = \left| \frac{\frac{1}{2}E}{V_{1+}} \right| = \frac{(g_0 + G)^2 - \frac{1}{4} g_1^2}{G g_1}$$

Now $g_0 = \frac{1}{2}(1/r_f + 1/r_b)$ and $g_1 = 2/\pi\,(1/r_f - 1/r_b)$. In practice, $1/r_b \ll 1/r_f$ and $1/r_b \ll 2/R$, so that the conversion loss ratio becomes

$$\frac{\pi}{2}\left(0{\cdot}15\,\frac{R}{r_f} + 1 + \frac{r_f}{R}\right)$$

where the approximation $\pi^2 \simeq 10$ has been used.

APPENDIX 3

Belevitch's Analysis of the Shunt Modulator with Stray Capacitance

The circuit analysed by Belevitch[3] is shown in Fig. 13. The following symbols will be used here:

$G = 1/R = \dfrac{1}{R_S} + \dfrac{1}{R_R}$

$g(t) = 1/r(t)$; it has a square-wave variation from g_f to g_b with a period T.

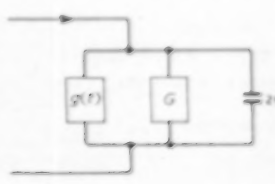

Fig. 13. Equivalent circuit of shunt modulator for Belevitch's analysis

ω_p = $2\pi/T$ = carrier angular frequency.
ω_q = signal angular frequency.

y_b	$= G + g_b \pm 2j\omega_q C$	The positive sign is taken here when the wanted sideband is $\omega_p + \omega_q$ and the negative sign when it is $\omega_p - \omega_q$.
y_f	$= G + g_f \pm 2j\omega_q C$	
s_b	$= G + g_b + 2j(\omega_p \pm \omega_q)C$	
s_f	$= G + g_f + 2j(\omega_p \pm \omega_q)C$	

Then applying these symbols to Belevitch's formulae, and correcting his misprints, we obtain the following expression giving the conversion loss ratio (represented by A_{CL})

$$\frac{1}{A_{CL}} = \frac{fG}{\pi}\left(\frac{1}{y_f} - \frac{1}{y_b}\right)\left[1 - j\omega_p C\left(\frac{1}{s_f} + \frac{1}{s_b}\right) - j\omega_p C\left(\frac{1}{s_f} - \frac{1}{s_b}\right)\frac{1 - \exp[-(y_f - y_b)T/4C]}{\exp(y_f T/4C) - \exp(-y_b T/4C)}\right] \quad \ldots \quad (1)$$

Thus the conversion loss is

$$20 \log_{10} |A_{CL}| \text{ dB}$$

Now Belevitch says this is too complicated to be useful as a basis of discussion, and he proceeds to deal with ideal rectifiers (i.e., $g_f = \infty$, $g_b = 0$) as a means of simplification. We will, however, first show that useful results can be obtained from Equ. (1) for non-ideal rectifiers. In what may well be the most important practical application of all—namely, a modulator used at a very high frequency—the circuit termination R may be of very low value and of the same order as the forward resistance r_f, so that the real part of y_f may be quite large. Nevertheless the time-constant in the forward condition, $2C/(G + g_f)$, may be much smaller than the carrier half-period, $T/2$, so that the exponential term

$$e^{y_f T/4C} \quad \ldots \quad (2)$$

has a very large magnitude. The exponential

$$e^{(y_f - y_b)T/4C} = e^{(y_f - g_b)T/4C} \quad \ldots \quad (3)$$

is entirely real and is necessarily smaller than (2), and in the conditions stated, is greatly smaller. For instance, if $G = g_f$, and g_b is small, then (2) is approximately the square of (3). Therefore, in these circumstances, the last term of Equs. (1) is negligible, and the formula becomes

$$\frac{1}{A_{CL}} = \frac{fG}{\pi}\left(\frac{1}{y_f} - \frac{1}{y_b}\right)\left[1 - j\omega_p C\left(\frac{1}{s_f} + \frac{1}{s_b}\right)\right] \quad \ldots \quad (4)$$

An example will be useful to illustrate this. Take the shunt modulator results of Fig. 6 for $R_S = R_R = 200\,\Omega$, $C = 0{\cdot}5\,\mu F$. Note that $r_f = 90\,\Omega$, $r_b = 500\,\text{k}\Omega$, $\omega_p = 1970 \times 2\pi$ rad/sec, $\omega_q = 390 \times 2\pi$ rad/sec. The measured conversion loss is 18·6 dB.

Equ. (1) is $\dfrac{f0{\cdot}01}{\pi}(-47{\cdot}1 + j17{\cdot}7)\,(1 - f0{\cdot}39 - 0{\cdot}425 - 0{\cdot}00875 + f0{\cdot}0066)$

showing that the last term is more-or-less negligible.

This gives $|A_{CL}| = 9{\cdot}13$; i.e., a conversion loss of 19·2 dB. The error of 0·6 dB between calculated and experimental results is not too serious, bearing in mind that the rather laborious calculation was done by slide-rule and the measured curves must be subject to some error (although at low losses the error does not exceed 0·2 dB).

It should be noted that the capacitance of 0·5 μF at a carrier frequency of about 2 kc/s corresponds to 1,000 pF at 1 Mc/s or 1 pF at 1,000 Mc/s. A high-frequency modulator, therefore, is very likely to be well within the stated conditions for the approximate result of Equ. (4); i.e., $C \simeq g_f$, $2C/(G + g_f) \ll T/2$.

Returning now to Belevitch's approximate formulae for ideal rectifiers, we insert the 'ideal' conditions

$$g_f = \infty \; ; \; g_b = 0 \quad \ldots \quad (5)$$

into Equ. (1). The result is

$$\frac{1}{A_{CL}} = \frac{fG}{\pi}\left[\frac{1}{G \pm 2j\omega_q C}\right]\left[1 - \frac{j\omega_p C}{G + 2j(\omega_p \pm \omega_q)C}\left\{1 + e^{-\alpha}\right\}\right] \quad (6)$$

where $\alpha = (G \pm 2j\omega_q C)T/4C$. This can be expressed as a modulus thus:

$$\left|A_{CL}\right| = \frac{\pi\sqrt{1 + 4\omega_q{}^2C^2R^2} \cdot \sqrt{1 + 4(\omega_p \pm \omega_q)^2C^2R^2}}{\sqrt{(1 + \omega_p{}^2C^2R^2\theta)}} \quad \ldots \quad (7)$$

where

$$\theta = e^{\pm j\omega_q CR} + \left(1 \pm 2\frac{\omega_q}{\omega_p}\right)^2 - 2\left[\left(1 \pm 2\frac{\omega_q}{\omega_p}\right)\cos\left(\pi\frac{\omega_q}{\omega_p}\right) \pm \left(1 \pm 2\frac{\omega_q}{\omega_p}\right)\sin\left(\pi\frac{\omega_q}{\omega_p}\right)\right]e^{\pm j\omega_q CR} \quad \ldots \quad (8)$$

The four constituents of A_{CL}, as indicated in Equ. (7), can be given separate interpretations thus:

(a) The factor π is the conversion loss ratio of a purely resistive modulator (with ideal rectifiers).

(b) The factor $\sqrt{1 + 4\omega_q{}^2C^2R^2}$ is the loss ratio due to the capacitance at the input signal frequency.

(c) The factor $\sqrt{1 + 4(\omega_p \pm \omega_q)^2C^2R^2}$ is the loss ratio due to the capacitance at the wanted sideband frequency.

(d) The factor $1/\sqrt{1 + \omega_q{}^2C^2R^2\theta}$ is what Belevitch calls an 'interaction' gain ratio due to the modulation process, and is vaguely analogous to the interaction loss of filter theory.

Sometimes, in practice, ω_q is so low compared with ω_p that it may reasonably be replaced by zero in the formulae. If we put $\omega_q \to 0$ in Equ. (7), then we obtain

$$\left|A_{CL}\right|_{\omega_q \to 0} = \frac{\pi \cdot \sqrt{1 + 4\omega_p{}^2C^2R^2}}{\sqrt{1 + [\omega_p CR(1 - e^{\pm j\omega_p CR})]^2}} \quad \ldots \quad (9)$$

A further approximation may also sometimes be useful. When both C and R are fairly high, it may occur that $2\omega_p CR \gg \pi$, so that

$$e^{\pm j\omega_p CR} \simeq 1 - \pi/2\omega_p CR \quad \ldots \quad (10)$$

Then Equ. (9) becomes

$$\left|A_{CL}\right| = \frac{2\omega_p CR}{\sqrt{(1 + \pi^2/4)}} \quad \ldots \quad (11)$$

for $\omega_q \to 0$; $2\,\omega_p CR \gg \pi$

These formulae for modulators with ideal rectifiers agree exactly with Belevitch's when all his misprints are corrected.

It is interesting to check the basic formula Equ. (7) for 'ideal' rectifiers against measured results. If values of C and R in the experiment are chosen so that both $1/\omega_q C$ and R are many times greater than r_f and smaller than r_b, then the effect of r_f and r_b not being zero and infinite respectively should be negligible. So take the condition (Fig. 6): $C = 0{\cdot}05\,\mu F$, $R_S = R_R = 20\,\text{k}\Omega$, giving $R = 10\,\text{k}\Omega$ and Equ. (7) gives a conversion loss of 27·8 dB. The loss from Fig. 6 is 29·2 dB, which represents very good agreement.

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U.S. ELECTRONICS CORPORATION FORMS U.K. COMPANY

The Consolidated Electrodynamics Corporation, Inc., U.S.A., have formed a new British company which is to be known as Consolidated Electrodynamics Corporation (U.K.) Ltd., and is to be situated at Woking, Surrey.

The initial activity of the new company will be the marketing of the range of electronic instruments of C.E.C. Inc. and the manufacture and marketing of a number of transducers and oscillographs.

PHYSICAL SOCIETY'S EXHIBITION 1962

The next annual exhibition of The Institute of Physics and The Physical Society is to be held at the Royal Horticultural Society's Halls, London, from 15th to 19th January 1962. As usual, admission will be by ticket only which will be available from The Secretary at 47 Belgrave Square, London, S.W.1.

COMPUTER MAGNETIC TAPE UNIT

The computer magnetic tape unit. Type 6000

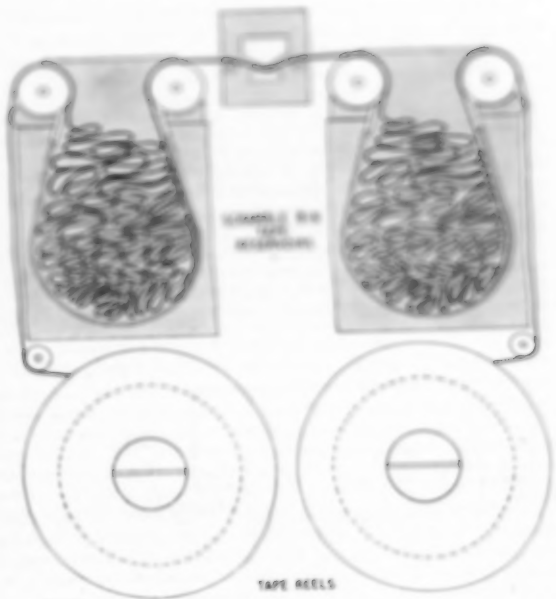

Fig. 1 (*above*). *A simplified drawing showing the arrangement of the tape reservoirs*

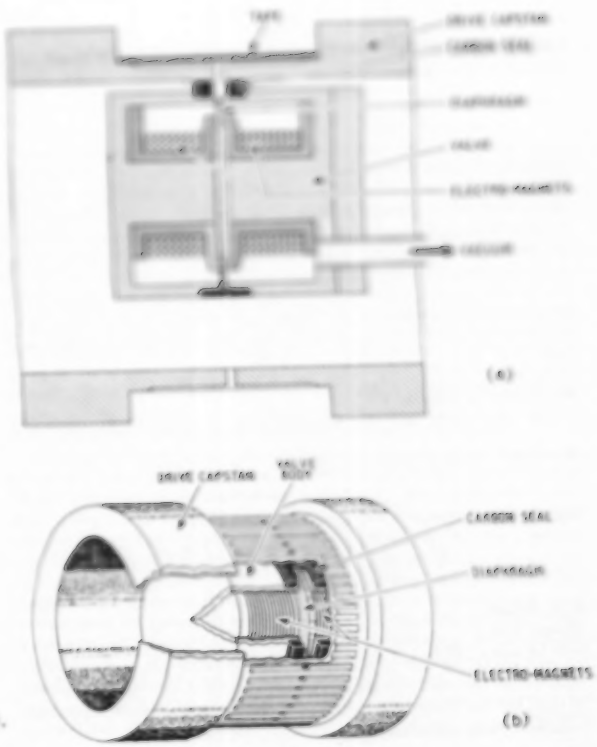

Fig. 2 (*right*). *A cross-sectional drawing of the capstan and air valve (a), and a perspective view of the assembly (b)*

ω_p $= 2\pi/T =$ carrier angular frequency.
ω_q $=$ signal angular frequency.

$y_b = G + g_b \pm 2j\omega_q C$
$y_f = G + g_f \pm 2j\omega_q C$
$u_b = G + g_b + 2j(\omega_p \pm \omega_q)C$
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Thus the conversion loss is

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$$e^{y_f T/4C} \quad .. \quad .. \quad .. \quad .. \quad .. \quad .. \quad .. \quad .. \quad (2)$$

has a very large magnitude. The exponential

$$e^{(y_f - y_b)T/4C} = e^{(g_f - g_b)T/4C} \quad .. \quad .. \quad .. \quad .. \quad .. \quad (3)$$

is entirely real and is necessarily smaller than (2), and in the conditions stated, is greatly smaller. For instance, if $G \simeq g_f$, and g_b is small, then (2) is approximately the square of (3). Therefore, in these circumstances, the last term of Equ. (1) is negligible, and the formula becomes

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$$g_f = \infty\ ;\ g_b = 0 \quad .. \quad .. \quad .. \quad .. \quad .. \quad .. \quad (5)$$

into Equ (1). The result is

$$\frac{1}{A_{CL}} = \frac{jG}{\pi}\left[\frac{1}{G \pm 2j\omega_q C}\right]\left[1 - \frac{j\omega_p C}{G + 2j(\omega_p \pm \omega_q)C}\left\{1 + e^{-\alpha}\right\}\right] \quad (6)$$

where $\alpha = (G \pm 2j\omega_q C)T/4C$. This can be expressed as a modulus thus:

$$|A_{CL}| = \frac{\pi\sqrt{1 + 4\omega_q{}^2C^2R^2} \cdot \sqrt{1 + 4(\omega_p \pm \omega_q)^2C^2R^2}}{\sqrt{(1 + \omega_p{}^2C^2R^2\theta)}} \quad .. \quad (7)$$

where

$$\theta = e^{-\pi/\omega_p CR} + \left(1 \pm 2\frac{\omega_q}{\omega_p}\right)^2 - 2\left\{\left(1 \pm 2\frac{\omega_q}{\omega_p}\right)\cos\left(\pi\frac{\omega_q}{\omega_p}\right) \pm (1/\omega_p CR)\sin\left(\pi\frac{\omega_q}{\omega_p}\right)\right\} e^{-\pi/2\omega_p CR} \quad .. \quad .. \quad (8)$$

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Sometimes, in practice, ω_q is so low compared with ω_p that it may reasonably be replaced by zero in the formulae. If we put $\omega_q \to 0$ in Equ. (7), then we obtain

$$\left|A_{CL}\right|_{\omega_q \to 0} = \frac{\pi \cdot \sqrt{1 + 4\omega_p{}^2C^2R^2}}{\sqrt{1 + [\omega_p CR(1 - e^{-\pi/2\omega_p CR})]^2}} \quad .. \quad .. \quad (9)$$

A further approximation may also sometimes be useful. When both C and R are fairly high, it may occur that $2\omega_p CR \gg \pi$, so that

$$e^{-\pi/2\omega_p CR} \simeq 1 - \pi/2\omega_p CR \quad .. \quad .. \quad .. \quad .. \quad .. \quad (10)$$

Then Equ. (9) becomes

$$|A_{CL}| = \frac{2\pi\omega_p CR}{\sqrt{(1 + \pi^2/4)}} \quad .. \quad .. \quad .. \quad .. \quad .. \quad (11)$$

for $\omega_q \to 0$; $2\,\omega_p CR \gg \pi$

These formulae for modulators with ideal rectifiers agree exactly with Belevitch's when all his misprints are corrected.

It is interesting to check the basic formula Equ. (7) for 'ideal' rectifiers against measured results. If values of C and R in the experiment are chosen so that both $1/\omega_p C$ and R are many times greater than r_f and smaller than r_b, then the effect of r_f and r_b not being zero and infinite respectively should be negligible. So take the condition (Fig. 6): $C = 0{\cdot}05\,\mu$F, $R_S = R_R = 20\,\text{k}\Omega$, giving $R = 10\,\text{k}\Omega$ and Equ. (7) gives a conversion loss of 27·8 dB. The loss from Fig. 6 is 28·2 dB, which represents very good agreement.

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[2] D. G. Tucker, "Modulators and Frequency Changers", Macdonald, London, 1953.
[3] D. G. Tucker, "Elimination of Even-Order Modulation in Rectifier Modulators", *J. Brit. Instn Radio Engrs*, Feb. 1961, Vol. 21, p. 161.
[4] V. Belevitch, "Linear Theory of Bridge and Ring Modulator Circuits", *Elect. Commun.*, 1948, Vol. 25, p. 62.
[5] V. Belevitch, "Théorie du modulateur a coupure shunté par capacité", *Rev. H.F., Brussels*, 1952, Vol. 2, p. 1.
[6] V. Belevitch, "Effect of Rectifier Capacitances on the Conversion Loss of Ring Modulators", *Trans. Inst. Radio Engrs*, CT 1, 1954, p. 41.

U.S. ELECTRONICS CORPORATION FORMS U.K. COMPANY

The Consolidated Electrodynamics Corporation, Inc., U.S.A., have formed a new British company which is to be known as Consolidated Electrodynamics Corporation (U.K.) Ltd., and is to be situated at Woking, Surrey.

The initial activity of the new company will be the marketing of the range of electronic instruments of C.E.C. Inc. and the manufacture and marketing of a number of transducers and oscillographs.

PHYSICAL SOCIETY'S EXHIBITION 1962

The next annual exhibition of The Institute of Physics and The Physical Society is to be held at the Royal Horticultural Society's Halls, London, from 15th to 19th January 1962. As usual, admission will be by ticket only which will be available from The Secretary at 47 Belgrave Square, London, S.W.1.

COMPUTER MAGNETIC TAPE UNIT

The tremendous advances made in the reliability of electronic computers over the last few years have set very high demands on the reliability of computer peripheral equipment. At the same time, the demand has been for higher performance equipment that will operate for long periods of time without maintenance.

High on the list of necessary peripheral equipment for digital data processing systems are reliable, high-speed magnetic tape units for input, output and storage applications.

Decca Radar have been active in the computer tape unit field since 1957 and now after considerable engineering effort they have developed a new equipment, embodying many operational and technical improvements, which is claimed to be the most advanced computer magnetic tape unit available in the world. It is designed so that it can be integrated with any data processing system.

This unit is known as the Type 4000 and two versions of the equipment with similar electrical and mechanical parameters are available for handling 1-in. and ½-in. tape. The standard cabinet contains one tape transport, electronic circuits, manual control panel with logical interlocks, head amplifier circuits, and power and vacuum supplies. Basically this is a unit which is capable of handling data at rates of 45,000, 90,000 and 180,000 characters per second with start/stop times of 1½ msec ±½ msec and a reverse time of 2½ msec ±½ msec.

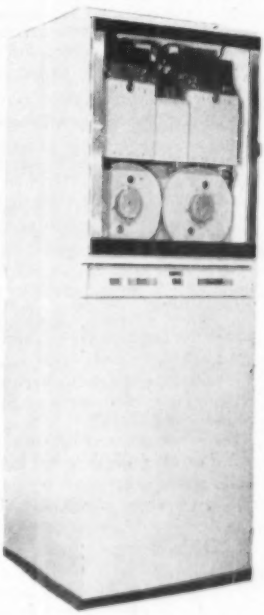
These very fast start, stop and reverse times have been achieved by using two pneumatic capstans to drive the tape and two scramble bin tape reservoirs or buffers in which sufficient loosely packed tape is stored to allow time for the smooth acceleration of the tape reels up to the normal operating speed. Fig. 1 illustrates the arrangement of the tape reservoirs.

Both capstans are belt driven from a synchronous motor and the tape drive is actuated by a changeover air valve within each capstan. When the tape is stationary it is out of contact with each revolving capstan, and when the tape drive is actuated a disc, which forms the armature of an electromechanical air valve, is displaced and a vacuum source is connected to air ports around the centre perimeter of the capstan and the tape is mechanically coupled to the capstan.

Fig. 2 (a) shows a cross-sectional drawing of the capstan and air valve while Fig. 2 (b) shows a perspective view of the assembly.

In specifying the performance of the equipment the designers have used extensively the method of worst-case design. For example, the type of spooling servo-system adopted is based on the performance required of a tape unit for handling 2-in. tape at 200 in./sec without programme restrictions, leading to a considerable margin of performance over that required for the 1-in. tape which is used at 150 in./sec. Also the start time of the equipment is quoted as the time at which the tape is running and remains running in correct registration with the recording head at the specified speed. This therefore specifies the time at which the tape may be used, and represents the parameter required by the system designer.

Designed in a modular form, the unit uses transistor logical circuits and a.c. induction motors; brush motors and relays have been eliminated. Apart from head-cleaning, design targets are for scheduled maintenance at 10,000 hr between regular maintenance operations, with minor attention at about 1000-hr intervals.



The computer magnetic tape unit Type 4000

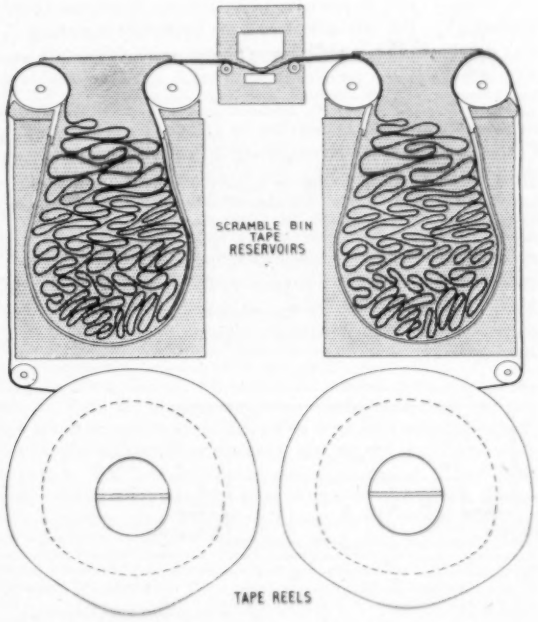


Fig. 1 (*above*). *A simplified drawing showing the arrangement of the tape reservoirs*

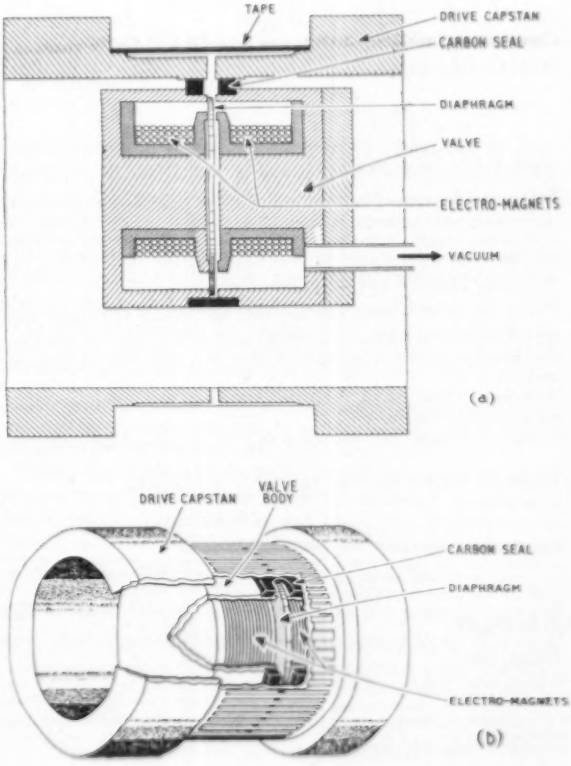


Fig. 2 (*right*). *A cross-sectional drawing of the capstan and air valve (a), and a perspective view of the assembly (b)*

Correspondence

Letters to the Editor on technical subjects are always welcome. In publishing such communications the Editors do not necessarily endorse any technical or general statements which they may contain.

Power in a Frequency-Modulated Wave

Sir,—Perhaps I may point out a certain interesting little property of a simple f.m. waveform and derive from it a general formula for the average power.

The notation of Mr. Medhurst et alia in your October or previous issues will be followed, in addition the symbol H for the highest common factor of ω_c and ω_m will be introduced.

It is clear that any simple f.m. wave $\cos[\omega_c t + m \sin \omega_m t]$ has a period $2\pi/H$, for increase t by this and we get:

$$\cos[\omega_c t + \omega_c 2\pi + m \sin[\omega_m t + \omega_m 2\pi]]$$

equal the original, for ω_c and ω_m are integers, given by:

$$\omega_c = H\,\omega_{cH}, \text{ and } \omega_m = H\,\omega_{mH}.$$

From an engineering viewpoint, one might suggest that what is of interest is the average power in that period. So to find it, we proceed as follows.

Since we are now concerned with a truly periodic function, it is no loss of generality to take the time of commencement of observation as 0.

Then average power may be written:

$$\overline{W_H} = \frac{V_c^2}{2R} \cdot \frac{H}{2\pi} \int_0^{\frac{2\pi}{H}} dt[1 + \cos(2\omega_c t + 2m \sin \omega_m t)]$$

$$= \text{(substituting } x = \omega_m t,\ k = 2\omega_c/\omega_m\text{)}$$

$$\frac{V_c^2}{2R} \cdot \frac{1}{2\pi\,\omega_{mH}} \int_0^{2\pi\omega_{mH}} dx\,[1 + \cos(kx + 2m \sin x)]$$

$$= \frac{1}{2\pi\,\omega_{mH}} \frac{V_c^2}{2R} S, \text{ say.}$$

The integral S may be broken up into a sum of ω_{mH} separate integrals, thus:

$$S = \int_0^{2\pi} + \int_{2\pi}^{2(2\pi)} + \int_{2(2\pi)}^{3(2\pi)} + \cdots\cdots + \int_{(\omega_{mH}-1)2\pi}^{\omega_{mH}(2\pi)}$$

Convert them to integrals between limits 0 and 2π by changes of variable of the form:

$$x = r(2\pi) + X, \text{ so,}$$

$$S = \int_0^{2\pi} dx \left\{ \sum_{r=0}^{r=\omega_{mH}-1} (1 + \cos[a(x) + r\,2\pi k]) \right\},$$

where $a(x) = kx + 2m \sin x$.

Evaluating the sum of the cosine terms, two cases have to be treated, depending on whether k is integral or not. If the former, the sum is simply: $\omega_{mH}(1 + \cos a(x))$ and $S = 2\pi\,\omega_{mH}(J_k(2m) + 1)$ and we have the special result given by Vaughan (1) and (2); i.e, $\overline{W} = (V_c^2/2R)(1 + J_k(2m))$.

But in the second, more general, case the sum of the cosine terms above reduces to zero. One usual way to sum such a series is to multiply up by $\sin \tfrac{1}{2}x$, write each term as a difference of sines, and add.

So now, $S = 2\pi\,\omega_{mH}$ and $\overline{W} = V_c^2/2R$, the same as in the unmodulated condition.

The two cases can be combined in a general formula, if a Kronecker delta is used; i.e., $\delta_q^p = 1, p = q$, thus:

$$= 0, p \neq q,$$

the average power in a f.m. wave is given by,

$$\overline{W} = \frac{V_c^2}{2R}\left\{1 + (\delta_{\omega_{mH}}^{k} + \delta_{\omega_{mH}}^{2k})\,J_k(2m)\right\}$$

J. Deignan.

Radio Eireann,
Athlone, Eire.
19th October 1961.

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Junction Transistor Theory

Sir,—I have found theoretically and experimentally that when a small forward voltage V of a few millivolts (the limiting value of this voltage varies from transistor to transistor) is applied to a p-n-p junction transistor of high emitter efficiency as shown in Fig. 1 (a), practically the whole of this voltage is absorbed as a forward voltage v_e across the emitter junction, while the reverse voltage v_c across the collector junction is practically zero. The axial current I_a obtained across the base under these conditions is several times larger than the transverse current I_t obtained by applying V directly across the emitter junction as in Fig. 1 (b).

The values of v_c and the non-thermal-equilibrium hole density in the base (p_{en}) being the same in both the cases, I_a exceeds I_t due to the geometry of the base. Since $h \gg w$, the hole density gradient in the base and the area of cross section of the diffusion current stream are larger in the axial direction than in the transverse. *This preponderance of the axial diffusion current in the base over the transverse, as a result of base geometry, seems to underlie the amplifying action of the p-n-p transistor.*

It follows from the theory of junction diodes[3] that when the transistor is connected as a diode in Fig. 1 (b), the diode current is mainly due to hole diffusion (under a concentration gradient) from a non-thermal equilibrium value at the emitter junction to thermal equilibrium value at the base contact, just as in a similar normal junction diode. When the collector connection is also completed to form an amplifier, the base current should still be mainly due to this reason. However, conventional theory ignores this primary component of the base current, and reckons mainly the electron current, entering the base through the base lead to replenish the base region electrons lost due to volume- and surface-recombination with the *axial* stream of holes, as constituting the base current in the amplifier circuit.

I_a in Fig. 1 (a) is proportional to p_{en} and can be increased only by increasing v_e. But this cannot be done by merely increasing V, as with increase in V, v_e rapidly comes to a saturation value. However, after keeping V at a sufficiently large value, v_e can be anchored to any value at will by applying a voltage $v_{e(b)}$ as in Fig. 2. Thus v_e, p_{en}, I_a and the power P_L released into a load connected in the collector circuit can be controlled by $v_{e(b)}$. This control of I_a and P_L by $v_{e(b)}$ constitutes the amplifying action in a junction transistor. Since the controlling voltage is applied to the input diode in the forward direction (unlike the case of the triode valve) it causes a signal-frequency current in the input circuit. Since v_e and I_a are exponentially related, while I_t and I_a (both proportional to p_{en}) are linearly related, the signal is to be applied as a current I_t, instead of as a voltage v_e, to preserve faithfulness of amplification. A large h/w ratio will keep the ratio of axial diffusion current to transverse, and consequently the common-emitter current amplification, large.

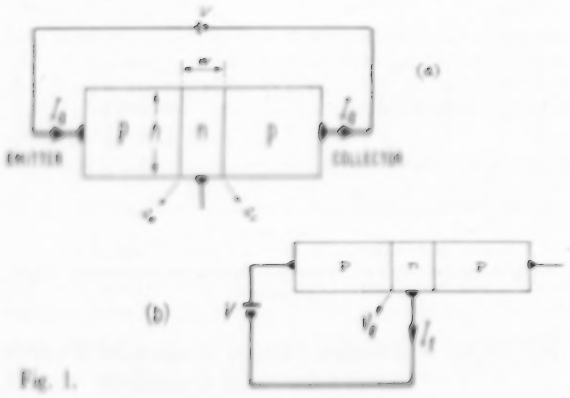

Fig. 1.

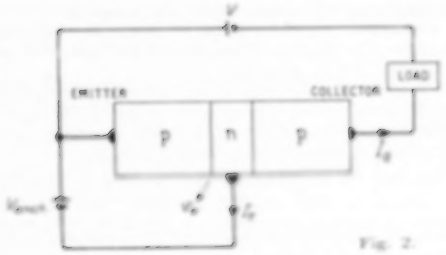

Fig. 2.

While the action of the ordinary junction transistor consists in applying a large voltage V in series with the two junctions and controlling I_E by directly controlling the voltage shared by the emitter junction, by applying a source of anchoring voltage, the action of the p-n-p photo transistor consists in indirect control of the voltage shared by the emitter junction by photo-generation of hole-electron pairs. Minority electrons generated in the collector by photon action in the vicinity of the junction, fall into the base under the action of a concentration gradient of electrons.. To complete the electrical path through the battery these electrons have first to cross the forward-biased emitter junction. To enable this, the barrier height at the emitter junction will have to be reduced by the required amount which means increase in v_E shared. This barrier reduction is inevitably accompanied by an enhanced flow of holes from the emitter to the base. Due to the high emitter efficiency, the hole current is much larger than the electron current causing it.

I have found that for a particular unit (at a certain temperature and applied V) for any value of v_E there is a unique value of collector current, irrespective of whether v_E is controlled directly by an anchoring voltage or indirectly by light intensity. It has also been found that a mere change of light intensity in a photo transistor does not produce any change in collector current, provided the change of v_E is prevented by the application of an anchoring voltage.

It has been further found that a mere change of base current in a p-n-p junction transistor without any change in v_E does not cause changes in collector current. For example, in a p-n-p double-base tetrode, with two base contacts on opposite sides of the base layer, if v_E is fixed, the base current obtained using one base contact is different from the I_b obtained with the other base contact. Also when both the base contacts are simultaneously used the total I_b is larger than that when only one contact is used. (Transverse hole diffusion proceeds to both the base contacts.) However, under all the three conditions the collector current remains the same.

The collector current is thus found to be a direct function of v_E and not of I_b or light intensity.

A detailed paper on this subject is to be published.

I also find that many phenomena in junction transistors, which are normally ascribed[3] to the presence of often unduly large surface recombination in the base are readily explainable, assuming little or no surface recombination, if transverse diffusion in the base under transverse minority carrier density gradient is taken into account. This too will be published later.

M. K. Achuthan.

Dept. of Electronics and Electrical Communication Engng.
Indian Institute of Technology,
Kharagpur, West Bengal, India.
2nd September 1961.

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A. R. Moore and W. M. Webster, "The Effective Surface Recombination of a Germanium Surface with a Floating Barrier", *Proc. Inst. Radio Engrs.*, Vol. 43, pp. 427–435, 1955.
W. M. Webster, "On the Variation of Junction Transistor Current Amplification with Emitter Current", *Proc. Inst. Radio Engrs.*, Vol. 42, pp. 914–920, June 1954.
E. W. Herold, "Some Advances in the Junction Transistor", *Brit. J. Appl. Phys.*, Vol. 5, pp. 153–159, April 1954.
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New Books

Elements of Maser Theory

By A. A. Vuylsteke. Pp. 362 + xiii. D. Van Nostrand Company Ltd., 358 Kensington High Street, London, W.14. Price 71s. 6d.

Maser theory synthesizes many of the main developments of modern quantum physics, each in itself a major subject for specialist study. The author, in fact, holds it responsible for initiating a new science, the science of "quantum electronics". The first half of this book deals with the quantum side; the calculation of the energy levels that give the spectroscopist's hyperfine structure, equilibrium populations of these levels as determined by statistical mechanics, and the interaction between radiation and matter.

Then, moving towards the electronics without letting go of the quantum, there are chapters on two-level excitation and the ammonia maser, on electron paramagnetic resonance and spin-lattice, spin-spin, and exchange interactions, and on the three-level solid-state maser. The last chapter discusses maser noise. There is an extensive list of references, and some of the more formidable mathematics is given in three appendices. The title "Elements" does not imply that the treatment is elementary, for it is a book for the post-graduate or research worker. Such readers will find it an admirably organized assembly of material that was previously only available in treatises on advanced theoretical physics and in original papers.

G.R.N.

Fundamentals of Signal Theory

By John L. Stewart. Pp. 346 + xiii. McGraw-Hill Publishing Company Ltd., 95 Farringdon Street, London, E.C.4. Price £3 10s.

At first sight, the title of this book seems inappropriate; for while "Signal Theory" is suggestive of perhaps the philosophy of communication and the theory of associated electronic processes, the mathematical content is of the kind normally found in modern books on network and system analysis and synthesis. On reflection, however, the processing of a signal for any purpose relies entirely on the characteristics of active and passive networks, and the title is therefore apposite, in the sense that network and system theory is indistinguishable from signal theory.

The book is welcome, for it presents compactly and with the minimum of difficulty the mathematical principles essential for understanding modern network and system theory. Yet it neither deals in detail with specific forms of network or system, nor is it purely a book on mathematics: the author has skilfully directed the treatment to networks and systems without writing a book that is merely a replica of the many that now exist on these topics.

The first four chapters lay the foundations of the complex-frequency plane or "pole-zero" approach, under the headings: Systems and vectors; System equations; Poles and zeros; and Additional pole-zero concepts. While differential equations properly dominate the chapter on system equations, operational methods and the Laplace transform are deferred until the sixth and seventh chapters, and the interpretation of the complex-frequency plane is confined at this stage to the sinusoidal steady-state. This is a point for approval rather than criticism: from the author's uncomplicated exposition, it emerges very clearly that the pole-zero approach in the sinusoidal case (which is of great practical importance anyway) represents an alternative view of alternating-current theory that for many purposes is more flexible and easier, yet which is little more difficult to understand than the approach to which most undergraduate

students are traditionally constrained. In particular, the advantages of the method for the algebraic or graphical evaluation of amplitude-frequency and phase-frequency characteristics is made apparent.

In most books on synthesis, the topic of approximation is placed quite late. Yet omission of at least the principles at an early stage is not logical, for as soon as the analytical significance of the polynomial transfer function and pole-zero pattern has been grasped, the reader is bound to reflect on the important converse problem of translating a given practical specification into a realizable polynomial function. Professor Stewart has obviously considered this point and has thoughtfully completed the picture by making "An Introduction to Approximation" his fifth chapter. The treatment includes the use of standard curves, Taylor, Butterworth and Chebyshev approximations, normalization, and frequency transformations.

Operational methods for the time-domain are introduced in chapter VI through a modified form of Heaviside calculus, which is used convincingly to derive many useful results, including solutions synonymous with Laplace transformation. The direct Laplace transformation is then developed in the following chapter, which includes also the Fourier transformation.

The remaining chapters VIII–XI deal with: Contour integration; Further aspects of complex-variable theory, in which is included the attenuation and phase theorems of H. W. Bode and Hilbert transforms; Fourier series and discrete spectra, including Gibbs phenomena, modulation, and impulse spectra; and Fourier integrals and continuous spectra, including a significant contribution on random pulses and waveforms.

There is little to criticize in the exposition. The writing is good throughout, the material is well chosen and presented in a considered sequence, and the chapters are smoothly correlated.

The book may be criticized for its lack of numerical illustrations, which in this reviewer's opinion always accelerate understanding, and also for the absence of answers to problems, which is a standard fault in American books.

Good American books in this field are invaluable for reference and specialized study, but not often is one directly adaptable to a lecture course within the British framework of technical education. This book is somewhat different, and may prove very useful to teachers planning courses on the mathematical principles of networks and systems.

F.E.R.

Shock Tubes

By J. K. Wright. Pp. 168 + vii. Methuen & Co. Ltd., 36 Essex Street, Strand, London, W.C.2. Price 13s. 6d.

The experimental shock wave is essentially a controlled version of the blast wave from an explosion, and the usual shock tube is a device for propagating shock waves in a gas by the sudden rupture of a diaphragm, or by an electromagnetic "piston" that drives a sheet of conducting ionized gas. Speeds of propagation up to something like Mach 200 are attained. This monograph deals with the structure and production of shock waves, and their reflection, refraction, and diffraction; with the optical and mechanical methods used to study the waves; and with the temperature and ionization conditions produced in the gas. It also discusses briefly the role of the shock tube in aeronautical studies of very high-speed projectiles, in problems on chemical reaction kinetics, and in the exploration of magnetohydrodynamics for the extraction of thermonuclear power and the propulsion of space vehicles. A useful and clear account of the subject which will put the non-specialist in the picture.

G.R.S.

"Wireless World" Diary 1962

Published by T. J. & J. Smith Ltd. in conjunction with *Wireless World*, Dorset House, Stamford Street, London, S.E.1. Price: leather bound 6s. 10d.; rexine bound 4s. 10d. (postage 4d. extra).

This well-known diary contains 80 pages of useful reference material, plus the usual diary pages of a week to an opening. Each year the reference material is revised and brought up to date. Some idea of the variety of information it includes will be gathered from the following selection from its contents: Addresses of Radio Organizations, Attenuators, B.A. Screws and Drill Sizes, M.K.S. and C.G.S. Units, Modulation Classification, Radar Bands, Standard Frequencies, Unit Abbreviations, Valve Base Connections, and Transistor Types and Connections.

An Introduction To Linear Network Analysis

By P. S. Farago, Dr.Phil., F.Inst.P., F.R.S.E. Pp. 335 + xii. Published by The English Universities Press Ltd., 102 Newgate Street, London, E.C.1. Price 30s.

"The purpose of this book is to derive from first principles, relations between electric currents and voltages in forms which are applicable to a large variety of practical problems, *i.e.* to the analysis of the properties of linear electric networks.

The fact that the considerations are confined to linear networks already defines the field which is surveyed. Within these limits one method is applied consistently to the study of lumped parameter networks, transmission lines and waveguides and networks containing thermionic valves."

The Antenna

By L. Thourel, Ingénieur A.M. et E.S.E. and translated by H. de Laistre Banting, A.M.Brit.I.R.E. Pp. 407 + xii. Published in Great Britain by Chapman & Hall Ltd., 37 Essex Street, London, W.C.2. Price 70s.

"This book is based on a course given at the French School of Civil Aviation and sets out to provide engineers with a means of choosing an antenna and rapidly assuming to a close approximation the eventual performance to be expected. It is also intended to help those not specialising in this field to familiarise themselves with the problems of antenna design."

Inventive Design of Logical Circuits

By Frederick C. Hennie III. Pp. 282 + x. Published by John Wiley & Sons Ltd., Gordon House, Greencoat Place, London, S.W.1. Price 40s.

"This book examines the behaviour of one- and two-dimensional iterative networks. It is written for persons working in the communication sciences, and is especially pertinent to the areas of information processing, switching theory, and computer design."

Encyclopaedie der elektrischen Leitungsnetze

Pp. 83. Published in German by Schweizerischer Elektrotechnischer Verein (SEV), Seefeldstr. 301, Zürich 8, Switzerland. Price DM7½.

Service Valve Equivalents. 2nd Edition

Pp. 37. Published by the Radio Society of Great Britain, New Ruskin House, Little Russell Street, London, W.C.1. Price 2s. (plus 6d. postage).

"It is hoped that this booklet will meet the need for a source of information on the commercial equivalents and the manufacturers of the numerous U.S. coded valves, cathode ray tubes and semiconductor devices now available to the radio amateur."

[illegible]

Reference Tables for Thermocouples (Copper v. Constantan). Pp. 15. B.S.1828 : 1961. Price 6s.

"B.S.I. has published another set of reference tables for the purpose of converting thermocouple voltages into equivalent temperatures.

Like the other reference tables in this series (B.S.1826 and 1827), they are based on the International Temperature Scale (1948) and on the Absolute Volt. . . ."

Gramophone Records and Reproducing Equipment

Pp. 19. B.S.1928 : 1961. Price 6s.

"This standard, which deals with gramophone records, associated reproducing equipment and direct recording blanks, is based on the International Electrotechnical Commission's Publication No. 98 "Recommendations for lateral-cut commercial and transcription disc recordings" and on No. 98-1 (Recommendations for stereophonic commercial disc records)."

Unified Miniature Screw Threads

Pp. 15. B.S.3369 : 1961. Price 5s.

"This new B.S. relates to unified miniature parallel screw threads from 1·40-mm down to 0·30-mm diameter (0·0551 in. to 0·0118 in.) having the 60° ISO Unified basic form of thread. . . .

The standard deals with thread form, diameter-pitch combinations and design sizes, limits tolerances and inspection and plated threads. It also deals with designation. . . ."

Indicating Tachometers: For General Industrial Use

B.S.3403: 1961. Pp. 20. Price 6s.

"This Standard specifies scale ranges, scales, constructional details, marking, performance and tests for three grades of tachometers, those with a nominal accuracy of ±(0·75)% ±1·5%, and ±3·0% of the maximum scale value."

Enamelled Copper Conductors (Glass-cotton enamel)
Pp. 27. B.S.156: Part 1: 1961. Price 3s. 6d.

Enamelled Copper Conductors (Enamel with Vinyl Acetal Base).
Pp. 37. B.S.1844: Part 1: 1961. Price 3s. 6d.

These publications are available from British Standards Institution, 2 Park Street, London, W.1.

MEETINGS

I.E.E.

7th *December*. Parsons Memorial lecture on "Magnetohydrodynamics", by Professor Sir W. Hartog, M.A.

8th *December*. Discussion on "The Driver, Hall and Seebeck Effects", to commence at 6 o'clock.

12th *December*. "Diversity Reception and Automatic Phase Reception", by L. Lewis.

13th *December*. "Large Microwave Steerable Aerials for Communication with Artificial Earth Satellites and Space Probes", by P. J. D. Vacher, O.B.E., B.Sc. (Eng.).

19th *December*. "The Use of Controllable Semiconductor Rectifiers in Machine Control", by K. G. King, D.F.H.

20th *December*. "Satellite Instrumentation", by R. L. F. Boyd, Ph.D., B.Sc. (Eng.).

These meetings will be held at the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2, and will commence at 5.30 unless otherwise stated.

Brit. I.R.E.

6th *December*. Discussion on "Possible Uses of Computers in Medical Diagnosis", to be opened by A. D. Booth, D.Sc.

13th *December*. Discussion on "Colour Television".

20th *December*. Programme of technical films.

3rd *January*. Symposium on "Data Transmission" to commence at 10 a.m.

These meetings will be held at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1, and will commence at 6 o'clock unless otherwise stated.

The Television Society

8th *December*. "Remote Control Operation of Television Cameras", by H. C. Nicholls.

11th *December*. "The 'Star Trek' Uniform Camera", by D. S. Brotherhood, Graphoscope (U.K.) Graphoscope Mark II (U.K.).

These meetings will be held at the Cinematograph Exhibitors' Association, 164 Shaftesbury Avenue, London, W.C.2, and will commence at 7 o'clock.

The Guild and Educational Association

13th *December*. "Loudspeaker Enclosures", by J. Gough and Professor F. Langford-Smith, to be held at the Royal Society of Arts, John Adam Street, London, W.C.2, at 7 o'clock.

The Institution of Electronics

15th *December*. A film show on electronic topics, to be held in the large lecture theatre, The London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C.1, at 7 o'clock.

The Institute of Physics and The Physical Society

12th *December*. "Integrated Electronics", by Dr. J. W. Granville, to commence at 5.30.

13th *December*. "Ferromagnetism and Antiferromagnetism", to commence at 11 a.m.

These meetings will be held at 47 Belgrave Square, London, S.W.1.

DR. D. A. BELL LEAVES BIRMINGHAM UNIVERSITY

A.M.F. Limited have announced the appointment of Dr. D. A. Bell as Director of their new research laboratory at Peppard, near Henley-on-Thames. Dr. Bell joins A.M.F. from the University of Birmingham, where for the last 12 years he has been on the staff of the Electrical Engineering Department.

A.M.F. Ltd. is a member of the American Machine & Foundry Co. The main purpose of the new research laboratory will be to undertake long range research in those fields of science which relate to the Company's industrial activities.

TALKING BOOKS FOR THE BLIND

The organisers of the Nuffield Talking Book Library for the Blind, the function of which is to distribute records and tape-playing equipment and records of readings of books, have asked for the assistance of radio engineers.

Volunteers are required to install and maintain machines for blind people. Service sheets and all spare parts are supplied by the Library and, in general, the time spent on this most useful work does not exceed one evening every 6–8 weeks.

Those offering help are asked in the first instance to write to Dr Finlay Maxwell, J. Clarkson & Co. Ltd., Galashiels.

COLORADO SCHLUMBERGER LINE

Plessey (Cleveland Ltd., have announced that they have accepted an offer by Schlumberger Ltd., U.S.A. to purchase or holding (30·7%) of the issued Ordinary Share Capital in The Solartron Electronic Group Limited.

STANDARD-FREQUENCY TRANSMISSIONS

(Communication from the National Physical Laboratory)

Deviations from nominal frequency for October 1961*

Date 1961 October	MSF 60 kc/s 1000 G.T. Parts in 10^{10}	Droitwich 200 kc/s 1000 G.T. Parts in 10^{10}
1	−149·9	−15
2	−150·0	−16
3	−150·1	−16
4	−150·0	−16
5	−150·1	−16
6	−150·2	−17
7	−150·2	−18
8	−149·8	−17
9	−149·9	−17
10	−150·0	−18
11	−149·8	−17
12	−149·8	−17
13	−149·8	−17
14	−149·9	−17
15	−150·0	−17
16	−150·0	−17
17	−150·0	−17
18	N.M.	−17
19	−150·1	−17
20	−150·1	−17
21	−150·1	−17
22	−149·9	−17
23	−150·1	−17
24	−150·2	−17
25	−150·3	−17
26	−150·2	−17
27	−150·3	−17
28	−150·3	−17
29	−150·2	−17
30	−150·3	−17
31	−150·4	−17

* *Nominal frequency corresponds to a value of* 9 192 631 770 *c/s for the caesium* $F,m\ (4,0) - F,m\ (3,0)$ *transition at zero field. N.M. — Not Measured.*

New Products

Digital Voltmeter-Counter

A comprehensive instrument which functions as a digital voltmeter, frequency meter, time interval meter, and a clock pulse source has been announced by Southern Instruments.

This is known as the Digital Voltmeter-Counter type M.1155. As a digital voltmeter it measures from 1 mV to 500 V. For frequency measurement it covers the range 0·1 c/s to 120 kc/s using a count period of 0·1, 1 or 10 sec. It also measures time intervals, which are defined by electrical signals or contact closure over the range 1 msec to 27·7 hr. Finally, it also provides

crystal-controlled clock pulses of 0·1, 1 and 10 msec, and 0·1, 1 and 10 sec.

This versatile instrument has a combined function and range switch and has a high input impedance on all functions.

A bright digital display is achieved with projection in-line indicators and a latching system, which is released momentarily at the end of each count, provides a continuous display that is uninterrupted by the counting period.

The instrument is mains powered and it is expected that quantity production will begin this month.

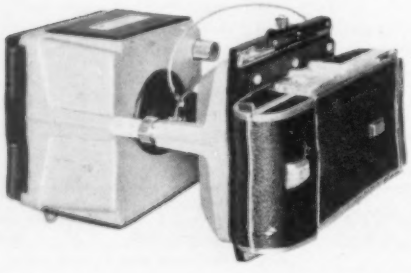
Southern Instruments Ltd.,
Frimley Road,
Camberley, Surrey.

C.R.O. Camera

A camera that accepts Polaroid or conventional film for the direct recording of oscilloscope traces has been announced by Tektronix.

Known as type C-13, it utilizes sliding back assembly (adjustable horizontally or vertically) on which the film-holding backs can be locked securely in five detent positions or rotated through 90° increments and locked.

It uses any of six interchangeable lenses in



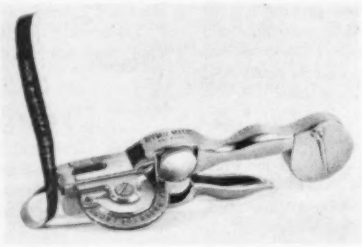
varying object-to-image ratios and a maximum aperture of f/1·5. The lenses are housed in uniform, pre-focused mounts.

Tektronix, Inc.,
P.O. Box 500,
Beaverton,
Oregon, U.S.A.

Hand Embossing Tool

Hellermann have announced a modified version of their Dymo hand embossing tool in kit form which will enable labels to be produced with the characters running horizontally or vertically.

The Dymo tool, which embosses labels on



metal and coloured p.v.c. tapes, with or without adhesive backing, can be supplied with two interchangeable dies for horizontal or vertical characters.

Hellermann Ltd.,
Gatwick Road,
Crawley, Sussex.

Variable Capacitance Diodes

Brush Crystal have announced two silicon variable capacitance diodes which have been designed to take the place of conventional trimmers and even ganged capacitors.

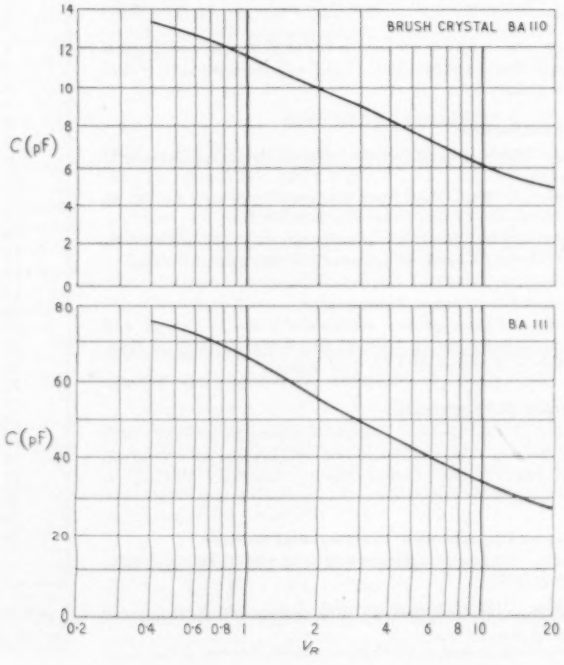
These diodes, types BA110 and BA111, have a capacitance which depends upon the reverse bias potential applied to them. In the case of the BA110 the capacitance is about 13 pF when the reverse bias is about 0·4 V and this changes to about 5 pF when the reverse bias is increased to 20 V. For the same voltages the type BA111 has a capacitance of about 75 pF and 28 pF. Both diodes are of conventional cylindrical shape with a lead projecting axially from each end; the body measures 7 mm long × 2·5 mm diameter and the leads are each 38 mm long.

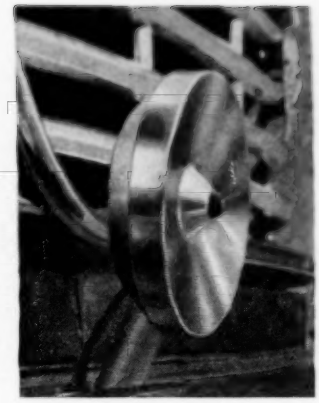
Brush Crystal Company Ltd.,
Hythe, Southampton.

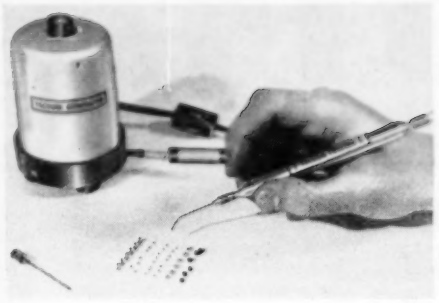
Icing-Road Indicator

A device for motor vehicles which has been designed as an indicator of ambient temperatures and therefore an indicator of possible icing on the roads has been produced by Findlay, Irvine Ltd.

This is known as the Icelert and it is basically a transistorized thermometer, which is mounted on the front of the vehicle, like a fog lamp, and a dash panel light. A transistor is used as the temperature-sensing element. The base-to-emitter voltage is kept constant and changes in junction temperature, resulting from changes in ambient temperature, cause the collector current to vary. Since the supply is stabilized and the transistor dissipation is negligible, the collector voltage is a function of temperature only. Variations in collector voltage are transmitted via an emitter-follower to the base of an earthed-emitter







transistor which has a pilot lamp as part of its collector load. A capacitor is connected from the collector of this transistor to the base of the temperature-sensing transistor, thereby providing positive feedback. The circuit components are so chosen that a low-frequency oscillation occurs over a temperature range of 3·5 °F starting at 35·5 °F with a short 'lamp on' time and ceasing at 32 °F when the lamp remains on continuously.

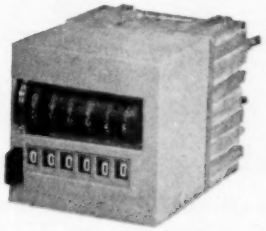
The device therefore gives an indication of ambient temperature, and thus is a measure of the probability of icing conditions.

Findlay, Irvine Ltd.,
Bog Road,
Penicuik, Near Edinburgh.

Batching and Indicating Counter

An electromagnetic counter now being produced by Lancashire Dynamo is designed to provide facilities for predetermined batch operation combined with an indication of the total count.

This counter is known as the Series P43; it is constructed so that it can be preset to operate an internal switch after any number



of counts up to 999,999. Manual and electrical reset facilities are provided and the units are designed for counting speeds of up to 1,500 impulses per minute for a range of input voltages from 6 to 220 V.

These counters are of the plug-in type with interlocking dove-tailed castings for building up blocks of units and they are available for flush panel and proud mounting.

Lancashire Dynamo Electronic Products Ltd.,
Rugeley, Staffs.

Vacuum Tweezer

A slim vacuum-operated tool which is designed for picking up miniature component parts is now available in the U.K. through L. E. Simmonds Ltd.

This is known as the Vacuum Tweezer System V-100; it comprises an electromagnetic vacuum generator with an adjustable pressure control and a vacuum pencil with a stainless steel tip. The vacuum pencil is similar in size to a propelling pencil and it is connected to the generator by flexible tubing which incorporates a dirt filter. Various shapes and sizes of pick-up tip are available.

To hold a component the operator simply touches its surface with the pick-up tip of the pencil, at the same time covering a small opening in the pencil body; uncovering the opening will release the pressure and the component.

L. E. Simmonds Ltd.,
5 Byron Road,
Harrow, Middlesex.

Thermocouple Amplifier

This instrument is specifically intended for the measurement of temperature rise above ambient of equipment and devices and for measuring potentials of low source impedance. It has a standard Chromel-

Alumel ambient reference junction built-in and makes provision for an external cold junction to be connected in place of the internal junction when it is required to measure temperature differences.

Three switched temperature ranges from 0–10 °C to 0–300 °C are provided along with three voltage ranges from 0–10 mV d.c. to 0–1 V d.c.; the input impedance is 50 kΩ.

In normal use the instrument is operated from the mains supply but when being used as a portable unit power is derived from internal re-chargeable batteries. The instrument is housed in a case measuring 11 in. × 7½ in. × 3½ in.

Grundy & Partners Ltd.,
3 The Causeway,
Teddington, Middlesex.

Twin-Channel Oscilloscope Pre-Amplifier

Telequipment have introduced the PA2 Twin-Channel Pre-Amplifier which although primarily designed for their double-beam Serviscope model D31 can be used with other oscilloscopes.

It has a self-contained power supply operating from the normal a.c. mains. Both channels are identical with a maximum gain, on the highest sensitivity range, of × 100 and a bandwidth of 2 c/s to 15 kc/s. Separation between the channels is better

than 10,000:1 and the combined hum and noise is not greater than 30 μV for each channel. The input impedance is 1 MΩ, 25 pF and the maximum permissible input is 300 mV.

Telequipment,
313 Chase Rd.,
London, N.14.

Miniature Hermetically-Sealed Meters

A range of hermetically-sealed meter movements weighing 2¼ oz. and with a scale length of 1¼ in. has been introduced by M.I.P.

Known as the Series 125, they are type approved to the S.R.D.E. specification 230/2. The 125 is also physically and electrically equivalent to the 1½ in. hermetically-sealed instrument in Specification DEF.62 when used with terminals instead of soldering posts.

The case, which is black anodized aluminium, has an outside diameter of approximately 1·77 in. It provides a sealed compartment for dry nitrogen at normal pressure.

A platform scale is fitted; the clearance between the pointer and the dial is greater

than is normal so that under severe vibration the pointer does not touch the sub-dial.

Instruments of the Series 125 are available for d.c. volts (50 mV–250 V), a.c. volts (2·5 V–250 V) and direct current (50μA–5 A).

The operating temperature for the moving-coil instruments is 85 °C to −40 °C and for the rectifier voltmeters 55 °C to −40 °C.

Measuring Instruments (Pullin) Ltd.,
Electrin Works,
Winchester Street, London, W.3.

Vibration-Sensitive Switch

The 'Vibraswitch' is a vibration-sensitive switch which has been designed primarily as a device to protect rotating and reciprocating machinery from damage resulting from mechanical malfunction. It is produced by Robertshaw-Fulton Control Company, U.S.A., and is available in the U.K. through Electro Methods.

When the vibration level of a machine fitted with this device exceeds that normally experienced by a pre-selected amount, an internal switch closes and can be used either to actuate a warning system or a shutdown

circuit. The switch rating is 7 A at 460 V a.c. and 5 A at or below 24 V d.c.

The sensitive axis of the device is perpendicular to the base and the sensitivity is adjustable by means of a set screw; one complete turn of the adjusting screw changes the sensitivity by 1 g. The Vibraswitch can be set to operate at accelerations between 0 and 4·5 g and the operating accuracy is ±5% of the full range from 0 to 300 c/s. A manual reset button and a reset coil are incorporated in the switch.

Electro Methods Ltd.,
Caxton Way,
Stevenage, Herts.

Electrometer

A precision electrometer capable of measuring very low currents and voltages has been announced by Wayne Kerr.

Known as the M141, the full scale ranges are 1 mV, 10 mV, 100 mV, 1 V, and 10 V d.c. and, using three standard resistors, from 10^{-15} A f.s.d. to 10^{-6} A f.s.d. The input resistance is greater than 10^{16} Ω and the input capacitance is approximately 1 pF, with a maximum charge sensitivity of 3×10^{-15} coulomb.

The stability and sensitivity of the instrument are such that it has been possible to include a decade switch preceding the meter. When the order of the measured quantity is known, the first digit of the reading can be transferred to the decade control, and the meter will then indicate the second and subsequent digits. This facility not only provides a measurement accuracy equivalent to 0·1% f.s.d. on all ranges, but also serves as a backing-off device which enables small variations to be measured with a high degree of discrimination.

The M141 operates on the dynamic capacitor principle with a high-Q resonant system at 1 kc/s. It is so constructed that calibration and set-zero adjustments can be effected without disturbing the external connections. A Weston cell is incorporated and can be brought into circuit automatically for calibration checks.

The electrometer measures 17½ in. × 11¾ in. × 10¼ in. and operates on 115 or 230 V a.c. supplies.

The Wayne Kerr Laboratories Ltd.,
44 Coombe Road,
New Malden, Surrey.

5-Digit Volt-Ohm Meter

An instrument which makes extensive use of semiconductor circuitry and has been designed to measure d.c. voltage and resistance, to an accuracy of better than 0·03% of reading or ±3 digits whichever is the greater, has been added to the Ferranti range of digital units.

The voltage range of this type D201 5-digit volt-ohm meter is 0·001 to 1,000·0 V d.c. and the resistance range is 000·01 Ω to 1,299·8 kΩ. The ranging is automatic on both inputs except for the most sensitive range in each instance, which is selected by a "divide by 10" switch. The conversion time is normally 25 msec, irrespective of reading, and the input impedance is 4·44 MΩ on all ranges, although this can be increased to 10 MΩ. Direct current can be measured from full scale readings of 1·0999 μA to 1·0999 mA after slight modification to the instrument.

Print out facilities are available and a parallel output may be fed to a suitable adaptor from the read-out sockets. Other outputs may be taken from the instrument, either as 28-V positive pulses from each decade, or in binary-coded form.

The instrument is housed in a cabinet measuring 20 in. by 15 in. by 14 in. and weighs approximately 35 lb; a rack-mounted version is also available.

Ferranti Ltd.,
Ferry Road,
Edinburgh 5.

Printed Wiring Kits

Electrosil are marketing a complete printed wiring kit with which simple printed wiring boards can be produced in about 15 minutes.

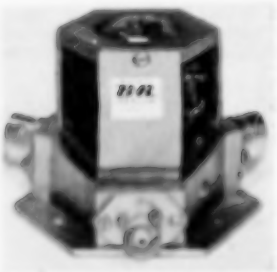
The kit comprises an etching tray, 2 grid boards, 2 bags of etching compound, a ball-point 'resist' applicator and a card of masking tape.

The board is a grid-like structure of copper-clad ceramic with standard component mounting holes of 0·052-in. diameter on 0·1-in. centres; the holes are through-copper-plated.

Electrosil Limited,
Colnbrook By-Pass,
Colnbrook, Slough, Bucks.

Coaxial Relay

Designed in conjunction with the B.B.C. a high-power coaxial relay type A10 is now being released generally by B. and R. Relays.



The A10 has been designed to handle 1 kW of r.f. power using type "C" or type "N" connectors. Contacts are of the single changeover type and of silver palladium. The coils are suitable for voltages up to 50 V d.c. and the characteristic impedance is 50 Ω.

At 65 Mc/s, the v.s.w.r. is less than 1·09 and the crosstalk is 63 dB down.

B. & R. Relays Ltd.,
Temple Fields,
Harlow, Essex.

CORRECTION

November issue, p. 426. The output of the Claude Lyons Automatic A.C. Stabilizer can be set to any voltage between 200 and 254 V and not, as stated, only in 10-V steps between these limits.

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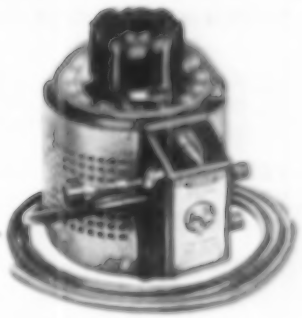

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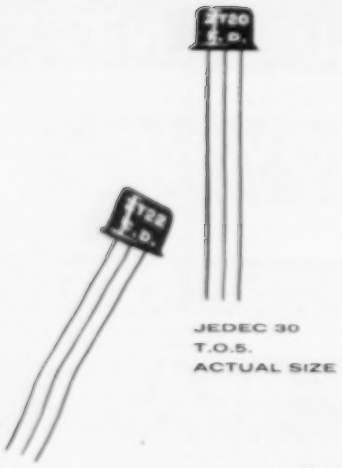

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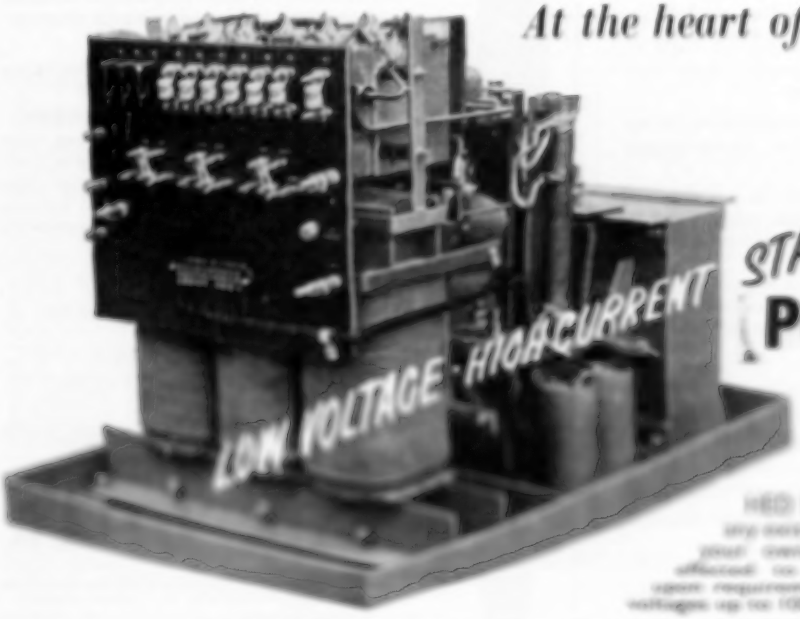

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ET/4

Electronic technology

From date for the January 1962 issue to first post 5th December 1961

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Advertisement Rates. 6d. per word, minimum charge 6s. each paragraph charged separately. Remittance payable to "Electronic Technology," Dorset House, Stamford St., S.E.1. Series discount 10%, is allowed for 12 consecutive insertions.

Box Numbers are available at an additional charge of 2s. to defray cost of registration and postage. Replies should be addressed Box No. 0000, c/o "Electronic Technology," Dorset House, Stamford Street, London, S.E.1.

Semi-Display advertisements with panel rule round (£15 15s. per single column inch) no additional charge for Box Number. The Publishers are not responsible for errors or printers' errors although every care is taken to avoid mistakes.

SITUATIONS VACANT

THE UNIVERSITY OF LEEDS
DEPARTMENT OF ELECTRICAL ENGINEERING

APPLICATIONS are invited for appointment as Lecturer in the Department of Electrical Engineering at a salary in the scale £1,365 to £2,085 a year, according to age, qualifications and experience. Applicants should have an Honours degree in Electrical or Electronic Engineering and experience in some branch of Electronic Engineering. Applications (three copies) together with the names of three referees, should reach The Registrar, The University, Leeds, 2, from whom further particulars may be obtained, not later than December 18, 1961. [1503

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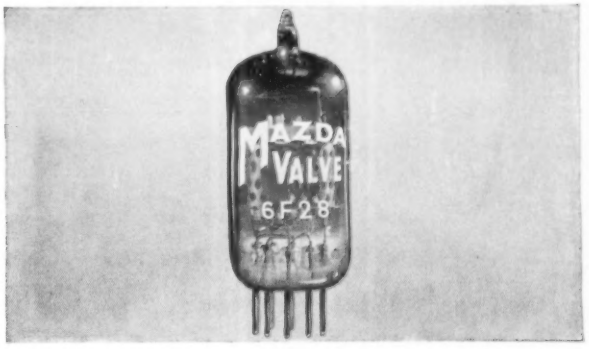
Heater Current (amps)	I_h	0.3



TENTATIVE RATINGS AND DATA

Maximum Design Centre Ratings

Anode Dissipation (watts)	$p_{a\,(max)}$	2.5
Screen Grid Dissipation (watts) ..	$p_{g2(max)}$	1.3
Anode Voltage (volts)	$V_{a(max)}$	250
Screen Grid Voltage (volts) ..	$V_{g2(max)}$	250
Heater to Cathode Voltage (volts rms)	$V_{h\text{-}k(max)\,rms}$	150*

*Measured with respect to the higher potential heater pin.

Inter-Electrode Capacitances†(pF)

Input	c_{in}	8
Output	c_{out}	2.5
Control Grid to Anode	$c_{g1\text{-}a}$	0.03

†Measured in fully shielded socket without can.

CHARACTERISTICS

Anode Voltage (volts)	V_a	180
Screen Grid Voltage (volts) ..	V_{g2}	180
Anode Current (mA)	I_a	10
Mutual Conductance (mA/V) ..	g_m	12.5

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	V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a (mA)
Average New Valve	70	180	−1	40
Assumed End of Life Condition ..	60	180	−1	25

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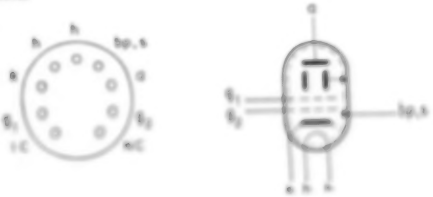

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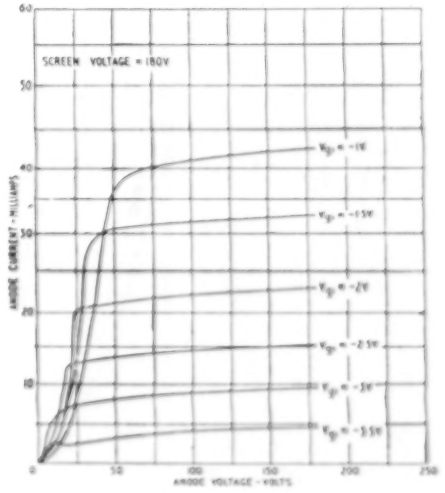
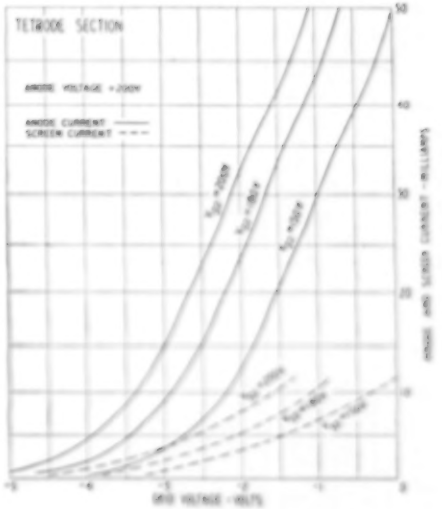
Tentative Characteristic Curves of Mazda Valve Type 6F28





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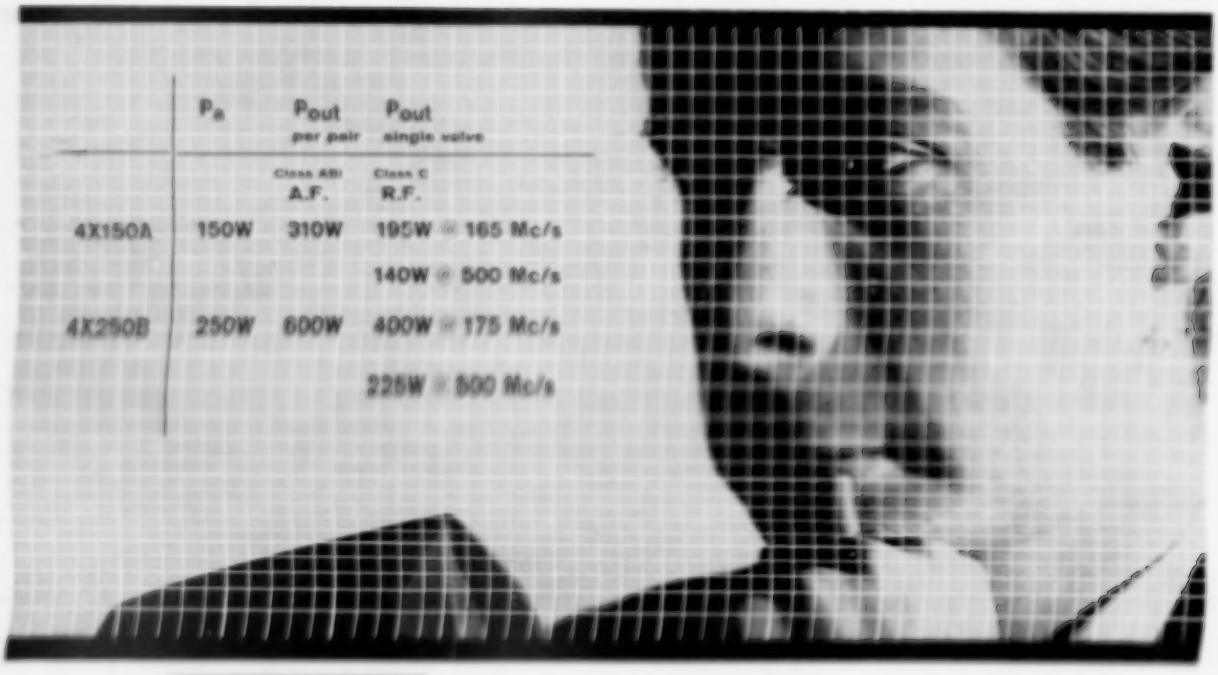

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ACOUSTICS AND AUDIO FREQUENCIES

534.133-8 **1**

Sources of Sound in Piezoelectric Crystals.—E. H. Jacobsen. (*J. acoust. Soc. Amer.*, Aug. 1960, Vol. 32, No. 8, pp. 949–953.) The production of sound in piezoelectric crystals is examined from the viewpoint of the inhomogeneous wave equation. The sound is generated by a gradient in the piezoelectric stress and, consequently, the free surfaces of a crystal are usually the most effective wave sources. The excitation of sound at microwave frequencies is also discussed.

534.2 **2**

The Behaviour of a Longitudinal Wave at the Boundary between Two Media.—M. Peschel. (*Hochfrequenztech. u. Elektroakust.*, Jan. 1960, Vol. 68, No. 6, pp. 221–226.) The transition from a solid elastic medium to (*a*) a different solid medium, (*b*) a nonviscous fluid, and (*c*) a vacuum is considered, and results are interpreted with the aid of electroacoustic analogues treated by quadripole theory.

534.2-14 **3**

Acoustic Measurements in Deep Water using the Bathyscaph.—M. Lomask & R. Frassetto. (*J. acoust. Soc. Amer.*, Aug. 1960, Vol. 32, No. 8, pp. 1028–1033.) A report of simple acoustic measurements made in the frequency range 10–500 c/s to depths of 3 200 m. The capabilities and limitations of the bathyscaph as a vehicle for acoustic experiments are discussed.

534.2-14: 534.88 **4**

Shallow-Water Under-Ice Acoustics in Barrow Strait.—A. R. Milne. (*J. acoust. Soc. Amer.*, Aug. 1960, Vol. 32, No. 8, pp. 1007–1016.) Recordings of ambient noise have been made in the frequency range 3 c/s–10 kc/s. The results show several harmonically related spectrum lines and, in particular, a prominent line near 7 c/s which appeared to have a wind-induced excitation.

534.23-8-14 **5**

The Transmission of Sound through a Wake.—E. G. Richardson. (*Proc. phys. Soc.*, 1st July 1960, Vol. 76, No. 487, pp. 25–32, plate.) Describes measurements of the diffraction of an ultrasonic beam produced in passing through wakes of cylinders in water and air. The ultrasonic wavelength was small compared with the vortex size. The decay of the vortices with distance behind the cylinder is discussed.

534.232: 538.652 **6**

Theoretical Investigations of the Complex Impedance of Magnetostrictive Extensional Ring Oscillators.—A. Fraude. (*Arch. Elektrotech.*, 19th Dec. 1959, Vol. 44, No. 7, pp. 399–418.)

534.373 **7**

Effect of Transport Processes on Attenuation and Dispersion in Aerosols.—S. L. Soo. (*J. acoust. Soc. Amer.*, Aug. 1960, Vol. 32, No. 8, pp. 943–946.) The dispersion and attenuation of sonic and ultrasonic sound waves in aerosols have been studied and effects of momentum and heat transfer between the solid particles and the gas considered.

534.6 **8**

The Improvement of Objective and Subjective Acoustic Measurement Techniques by the Use of F.M. Band Noise.—H. Niese. (*Hochfrequenztech. u. Elektroakust.*, Jan. 1960, Vol. 68, No. 6, pp. 193–202.) A comparison of the results of measurements obtained with bands of white noise and with constant-amplitude f.m. noise of narrow bandwidth shows the advantage of the latter method in revealing greater detail in the measured characteristics.

534.614-14 **9**

Sound Velocity Measurement in Liquids.—W. D. Wilson & D. D. Taylor. (*Electronics*, 9th Sept. 1960, Vol. 33, No. 37, pp. 69–71.) An application of the method described by Greenspan & Tschiegg (1296 of 1958). Two 5-Mc/s crystals are used with pulse duration 0·05 μs. Sound velocity is determined from the pulse repetition frequency which is adjusted so that a new pulse is initiated each time a reflected pulse returns to the transmitter. Dissolved impurities down to 1 part in 10^8 can be detected.

534.76 **10**

Location Tests for Intensity-Type Stereophony.—K. Wendt. (*Frequenz*, Jan. 1960, Vol. 14, No. 1, pp. 11–14.) The results are analysed of subjective tests to determine the apparent direction of the sound as a function of the sound-level difference of the radiator in a two-channel system. The dependence of this relation on frequency is also investigated.

534.79 **11**

The Inertia of Loudness Growth as a Function of Sound Level.—H. Niese.

(*Hochfrequenztech. u. Elektroakust.*, Dec. 1959, Vol. 68, No. 5, pp. 143–152.) Subjective tests were made to investigate the dependence of the 'inertia' effect in hearing (1426 of 1959) on sound level. The results are considered in relation to the design of objective loudness meters.

534.79 **12**

The Subjective Loudness Measurement of Band-Pass Noise with Uniformly and Differently Applied Bandwidths for Each Ear to Obtain Laws Governing Hearing and their Simulation in Objective Loudness Measurements.—H. Niese. (*Hochfrequenztech. u. Elektroakust.*, Jan. 1960, Vol. 68, No. 6, pp. 202–217.)

621.395.614 **13**

High-Frequency Calibration of an ADP Crystal Microphone.—P. A. Macpherson & D. B. Thrasher. (*J. acoust. Soc. Amer.*, Aug. 1960, Vol. 32, No. 8, pp. 1061–1064.) The free-field sensitivity of a microphone over the frequency range 10–100 kc/s is determined by the reciprocity technique, in which the transducers are oriented perpendicular to each other in order to minimize diffraction effects.

AERIALS AND TRANSMISSION LINES

621.315.212 **14**

Broad-Band Coaxial Choked Coupling Design.—H. E. King. (*Trans. Inst. Radio Engrs*, March 1960, Vol. MTT-8, No. 2, pp. 132–135. Abstract, *Proc. Inst. Radio Engrs*, June 1960, Vol. 48, No. 6, Part 1, p. 1194.)

621.315.212: 621.372.51 **15**

Analysis of Split Coaxial-Line-Type Balun.—H. Kogō. (*Trans. Inst. Radio Engrs*, March 1960, Vol. MTT-8, No. 2, pp. 245–246.)

621.315.212.018.44 **16**

The Skin Effect in Tubes and Coaxial Lines.—W. Held & K. Wenzel. (*Arch. Elektrotech.*, 1st Sept. 1959, Vol. 44, No. 5, pp. 306–317.) The skin effect is calculated for any frequency, using Maxwell's equations.

621.372.2 **17**

A Study of Multielement Transmission Lines.—H. Kogō. (*Trans. Inst. Radio Engrs*, March 1960, Vol. MTT-8, No. 2, pp. 136–142. Abstract, *Proc. Inst. Radio Engrs*, June 1960, Vol. 48, No. 6, Part 1, p. 1194.)

621.372.2 **18**

Complementarity in the Study of Transmission Lines.—G. H. Owyang & R. King. (*Trans. Inst. Radio Engrs*, March 1960, Vol. MTT-8, No. 2, pp. 172–181. Abstract, *Proc. Inst. Radio Engrs*, June 1960, Vol. 48, No. 6, Part 1, p. 1195.)

621.372.2: 621.317.332.1 **19**

Investigation of Balanced High-Frequency Transmission Lines.—K. Lauterjung. (*Arch. elekt. Übertragung*, Jan. 1960, Vol. 14, No. 1, pp. 26–36.) The transfer characteristics of a balanced shielded line are investigated relating to its application as a measuring line. The importance of balancing input and output terminations is considered, and two types of measuring-line structure are examined. The design of a balanced measuring line with an impedance of 240 Ω for the frequency range 150–650 Mc/s is illustrated.

621.372.2: 621.372.51 **20**

A General Theorem on an Optimum Stepped Impedance Transformer.—H. J. Riblet. (*Trans. Inst. Radio Engrs*, March 1960, Vol. MTT-8, No. 2, pp. 169–170. Abstract, *Proc. Inst. Radio Engrs*, June 1960, Vol. 48, No. 6, Part 1, p. 1195.) See also 285 below, and 3594 of 1959 (Solymar).

621.372.2: 621.372.51 **21**

Stepped Transformers for Partially Filled Transmission Lines.—D. J. Sullivan & D. A. Parkes. (*Trans. Inst. Radio Engrs*, March 1960, Vol. MTT-8, No. 2, pp. 212–217. Abstract, *Proc. Inst. Radio Engrs*, June 1960, Vol. 48, No. 6, Part 1, p. 1195.)

621.372.2: 621.396.679.4 **22**

The Goubau Line for Transmitter Applications: Properties and Operational Experience.—F. R. Huber & H. Rudat. (*Rundfunktech. Mitt.*, Dec. 1959, Vol. 3, No. 6, pp. 277–283.) The use of the Goubau line as a feeder for a v.h.f. transmitter aerial is described.

621.372.821: 621.372.832.6 **23**

Wide-Band Strip-Line Magic-T.—E. M. T. Jones. (*Trans. Inst. Radio Engrs*, March 1960, Vol. MTT-8, No. 2, pp. 160–168. Abstract, *Proc. Inst. Radio Engrs*, June 1960, Vol. 48, No. 6, Part 1, p. 1195.)

621.372.823: 621.372.852.22 **24**

Features of Cylindrical Waveguides containing Gyromagnetic Media.—R. A. Waldron. (*J. Brit. Instn Radio Engrs*, Sept. 1960, Vol. 20, No. 9, pp. 695–706.) The variations of e.m. field components and power flow are presented as functions of position in the transverse plane for the H_{11} mode in a waveguide of radius a containing a concentric ferrite rod of radius b. Values of b/a from 0 to 1 are taken, and results are discussed in relation to phase-constant curves previously obtained (341 of 1959).

621.372.825 **25**

A Contribution to the Theory of Corrugated Guides.—G. Piefke. (*J. Res. nat. Bur. Stand.*, Sept./Oct. 1960, Vol. 64D, No. 5, pp. 533–555.) The results of three previous papers (3035 of 1957, 2625 of 1958 and 1075 of 1959) are summarized, and the mathematical method for calculating the transmission characteristics of corrugated guides is briefly recapitulated.

621.372.825: 621.372.852.323 **26**

Nonreciprocal Attenuation of Ferrite in Single-Ridge Waveguide.—T. S. Chen. (*Trans. Inst. Radio Engrs*, March 1960, Vol. MTT-8, No. 2, pp. 247–248.) Three types of isolators are investigated: resonance-absorption and field-displacement types, and isolators operating in low-bias magnetic fields.

621.372.829: 621.374.5 **27**

The Behaviour of the Helical Line as a Delay Line with particular regard to Attenuation and Characteristics in Rotating Fields.—G. Piefke. (*Arch. elekt. Übertragung*, Jan. 1960, Vol. 14, No. 1, pp. 15–25.) The theory of the helix waveguide developed in 2459 of 1959 is applied to the case of the delay line, taking account of the finite conductor thickness and assuming the wavelength in the guide to be much greater than the spacing between turns.

621.372.829: 621.385.632.12 **28**

Experimental Investigation of the Efficiency of a Helix Waveguide.—G. A. Silenok, A. K. Berezin, P. M. Zeĭdlits & A. M. Nekrashevich. (*Zh. tekh. Fiz.*, Aug. 1959, Vol. 29, No. 8, pp. 946–953.) The frequency dependence of the efficiency of a helix waveguide as a slow-wave structure in the range of 150–800 Mc/s has been determined. Results of measurements are in agreement with theoretical calculations made using a sheath model.

621.372.832.4 **29**

Resonant Modes in Waveguide Windows.—M. P. Forrer & E. T. Jaynes. (*Trans. Inst. Radio Engrs*, March 1960, Vol. MTT-8, No. 2, pp. 147–150. Abstract, *Proc. Inst. Radio Engrs*, June 1960, Vol. 48, No. 6, Part 1, p. 1195.)

621.372.832.6 **30**

The Magic T.—W. Stösser. (*Frequenz*, Jan. 1960, Vol. 14, No. 1, pp. 17–19.) The properties of waveguide hybrid junctions and their matching conditions are obtained with the aid of the scattering matrix.

621.372.852.12: 621.317.34 **31**

Half-Round Inductive Obstacles in Rectangular Waveguide.—D. M. Kerns. (*J. Res. nat. Bur. Stand.*, April–June 1960, Vol. 64B, No. 2, pp. 113–130.) Formulae for the energy reflected by one, or two opposed semicircular cylindrical indentations in the narrow walls appear accurate enough for the configuration to be used as a calculable standard of reflection or impedance.

621.372.852.323 **32**

On the Theory of the Ferrite Resonance Isolator.—E. Schlömann. (*Trans. Inst. Radio Engrs*, March 1960, Vol. MTT-8, No. 2, pp. 199–206. Abstract, *Proc. Inst. Radio Engrs*, June 1960, Vol. 48, No. 6, Part 1, p. 1195.)

621.372.853: 621.385.632.19 **33**

Nonperiodic Slow-Wave and Backward-Wave Structures.—P. J. B. Clarricoats & R. A. Waldron. (*J. Electronics Control*, June 1960, Vol. 8, No. 6, pp. 455–458.) "The behaviour of the phase constant as a function of frequency is examined in the neighbourhood of cut-off for a waveguide of circular cross-section containing a

concentric rod of dielectric or ferrite material. It is predicted from this behaviour that with suitable choices of geometry and properties of the rod, slow waves or backward waves will propagate."

621.396.67 **34**

Cylindrical Antenna Theory.—R. H. Duncan & F. A. Hinchey. (*J. Res. nat. Bur. Stand.*, Sept./Oct. 1960, Vol. 64D, No. 5, pp. 569–584.) A survey of cylindrical-aerial theory relating to a tubular model with a narrow gap. Numerical results are presented for two typical examples.

621.396.67.095 **35**

Uniqueness of the Solution to Integral Equations of the First Kind in the Theory of Aerials.—N. N. Govorun. (*Dokl. Ak. Nauk S.S.S.R.*, 1st May 1960, Vol. 132, No. 1, pp. 91–94.) Fredholm's integral solutions of the first kind are obtained for the current density of an aerial represented as a body of revolution with a surface impedance. The uniqueness of solution is analysed in the case of perfectly conducting aerials.

621.396.67.095(204) **36**

Field Strength Measurements in Fresh Water.—G. S. Saran & G. Held. (*J. Res. nat. Bur. Stand.*, Sept./Oct. 1960, Vol. 64D, No. 5, pp. 435–437.) Depth/attenuation figures derived from experimental observations to 1 000 ft at 18·6 kc/s are compared with theoretical values.

621.396.674.3 **37**

Ways towards the Optimum Wide-Band Omnidirectional Radiator.—W. Stöhr & O. Zinke. (*Frequenz*, Jan. 1960, Vol. 14, No. 1, pp. 26–35.) Locus curves are given and reflection coefficients plotted for ellipsoidal, spherical and conical radiators of various length/diameter ratios, with a conical transition to the coaxial feeder. The effects of the shape of the transition section and the proportions of the radiator on matching and radiation characteristics are discussed. Optimum results are obtained with a modified hemispherical radiator with specially shaped conical transition.

621.396.677 **38**

Experimental and Theoretical Investigations of Plane Surface Aerials.—S. Blume. (*Z. angew. Phys.*, Jan. & Feb. 1960, Vol. 12, Nos. 1 & 2, pp. 39–47 & 72–87.) The field theory of surface aerials without rotational symmetry is developed, and experimentally obtained radiation diagrams are given and discussed.

621.396.677.3 **39**

Digital Instrumentation of Antenna Measurements.—E. K. Damon. (*Electronics*, 14th Oct. 1960, Vol. 33, No. 42, pp. 90–93.) A test system, incorporating a digital computer, is described for measurements of amplitude and differential phase shift of the signal at a number of points along an end-fire array.

621.396.677.4 **40**

The Triangular 'V' Aerial.—E. O. Willoughby. (*Proc. Instn Radio Engrs, Aust.*, Aug. 1960, Vol. 21, No. 8, pp. 517–523.) In the aerial described a smooth transition from transmission line to aerial aperture is achieved using triangular plates. Results obtained with experimental u.h.f. and h.f. aerials show a 3 or 4 : 1 bandwidth with good impedance matching, no beam splitting and gains at h.f. of 18 dB.

621.396.677.45 **41**

Equivalence of 0 and −1 Space Harmonics in Helical Antenna Operation.—T. S. Maclean & D. A. Watkins. (*Trans. Inst. Radio Engrs*, March 1960, Vol. MTT-8, No. 2, p. 251.) Identical results are obtained whether the fundamental or the −1 space harmonic is considered, the first relating to propagation along the conductor and the second to propagation axially.

621.396.677.6 : 621.396.663 **42**

Theory of the General Adcock.—K. Baur. (*Arch. elekt. Übertragung*, Jan. & Feb. 1960, Vol. 14, Nos. 1 & 2, pp. 1–14 & 57–70.) Comprehensive theoretical treatment of the stationary Adcock direction finder. Various practical problems of Adcock design and performance are solved with the aid of the basic concept discussed.

621.396.677.71 : 537.56 **43**

Radiation and Admittance of an Insulated Slotted-Sphere Antenna Surrounded by a Strongly Ionized Plasma Sheath.—J. W. Marini. (*J. Res. nat. Bur. Stand.*, Sept./Oct. 1960, Vol. 64D, No. 5, pp. 525–532.) The performance of a slotted sphere is computed from the voltage distribution along the slot, and the optimum operational frequency is obtained.

621.396.677.73 **44**

Wide-Band Matching of Horn-Parabola Aerials.—H. Laub. (*Frequenz*, Dec. 1959, Vol. 13, No. 12, pp. 390–397.) The design is given of a junction between circular waveguide and a horn-parabola aerial [2628 of 1956 (Laub & Stöhr)]. This design permits aerial operation over the range 3·6–11·7 Gc/s with a reflection factor < 1%.

621.396.677.83 : 621.396.65 **45**

Optimum Design of Microwave Periscopes for Radio Link Installations.—P. Münzer. (*Telefunken Ztg*, Dec. 1959, Vol. 32, No. 126, pp. 269–278. English summary, pp. 293–294.) The design is detailed of a radio-link aerial system in which the curved transmitter aerial is pointed upwards so that its radiation impinges on a plane reflector mounted on a tower, which deflects the radiation into the horizontal plane. See e.g. 38 of 1960 (Possenti.)

621.396.677.831 **46**

Investigation of the Reflection Characteristics of Plane Reflectors in the Decimetre Range.—E. Dänzer & K. E. Müller. (*Hochfrequenztech. u. Elektroakust.*, Jan. 1960, Vol. 68, No. 6, pp. 185–190.) Report of experimental investigations at 23·8 cm λ with an array of four independently adjustable square metal mirrors illuminated by a transmitter at a distance of 5·75 km. The radiation diagrams obtained are compared with calculated characteristics.

621.396.677.832 **47**

High-Gain, Very-Low-Side-Lobe Antenna with Capability for Beam Slewing.—A. C. Wilson. (*J. Res. nat. Bur. Stand.*, Sept./Oct. 1960, Vol. 64D, No. 5, pp. 557–561.) Theoretical results for the radiation patterns of a large corner-reflector aerial are compared with practical measurements with the main beam 10° off the forward direction. Close agreement is obtained.

621.396.677.85 : 621.396.965 **48**

Properties of Phased Arrays.—W. H. Von Aulock. (*Proc. Inst. Radio Engrs*, Oct. 1960, Vol. 48, No. 10, pp. 1715–1727.) Multi-element planar and linear arrays of equally spaced radiators are considered. The effect of scanning, by the introduction of phase delay, on the width, shape and direction of the main beam and on the side-lobe pattern are calculated, making use of a projection of the unit sphere on the plane of the array rather than two orthogonal planes.

AUTOMATIC COMPUTERS

681.142 **49**

Large-Storage Binary-to-Decimal Converter.—G. Dearnaley, L. G. Lawrence & H. C. Tresise. (*J. sci. Instrum.*, July 1960, Vol. 37, No. 7, pp. 240–242.) A digital converter is described which will handle 24-binary-digit numbers with a maximum input speed of 4 bits/s.

681.142 **50**

'Isabel' (Iso Status Accumulating Binaries using Extraordinary Logic).—J. A. Goss. (*Electronic Engng*, Oct. 1960, Vol. 32, No. 392, pp. 630–634.) "An improved logical arrangement of a decimal counter based on bistable elements is described. The advantages over usual methods are described, and the performance of various circuits using this method is given."

681.142 **51**

Input and Output Devices for Computers.—(*J. Brit. Instn Radio Engrs*, Sept. 1960, Vol. 20, No. 9, pp. 657–683.) The following papers were presented at a symposium held in London, 4th November 1959.

(*a*) The Transport of Paper Tape in Digital Computation.—A. D. Booth (pp. 657–660.)

(*b*) A High-Speed Tape Reader.—R. D. Lacy (pp. 661–668.)

(*c*) A New 600-Cards-per-Minute Card Reader.—H. H. G. Groom (pp. 669–674.)

(*d*) High-Speed Printers.—W. A. J. Davie (pp. 675–683.)

681.142 : 621-526 **52**

Analysing Magnetically Detented Stepper Servo Motors.—Weber & Weiss. (See 335.)

681.142: 621.318.57: 539.23 53

A Vacuum-Evaporated Random-Access Memory.—K. D. Broadbent. (*Proc. Inst. Radio Engrs*, Oct. 1960, Vol. 48, No. 10, pp. 1728–1731.) The basic multiple-layer magnetic-film structure described is shown to have valuable properties in coincident-signal switching applications, including low magnetic turnover time and extremely small cell volume.

681.142: 621.398 54

A Special-Purpose Analogue-Digital Converter.—G. C. Henderson. (*Electronic Engng*, Oct. 1960, Vol. 32, No. 392, pp. 602–608.) For use in analysing tape recordings of time-multiplex telemetry signals. One channel is analysed at each playback, and known transducer nonlinearities and drifts of gain and level are compensated.

CIRCUITS AND CIRCUIT ELEMENTS

621.316.825.4 55

Thermistors, their Theory, Manufacture and Application.—R. W. A. Scarr & R. A. Setterington. (*Proc. Instn elect. Engrs*, Part B, Sept. 1960, Vol. 107, No. 35, pp. 395–405. Discussion, pp. 405–409.) 80 references.

621.318/.319: 621.372.22 56

Line Equations for an Inhomogeneous Line System of Cylindrical Symmetry and their Application to Circuit Elements.—H. Heywang. (*Frequenz*, Dec. 1959, Vol. 13, No. 12, pp. 397–400.) Examples considered include the calculation of the skin effect of cylindrical wires, the frequency response of disk-type and wound capacitors, and the impedance of a sintered-Ta electrolytic capacitor.

621.318.57: 621.382.3 57

The Realization of Switches for Both Current Directions using Junction Transistors.—W. Hilberg. (*Elektronische Rundschau*, Dec. 1959, Vol. 13, No. 12, pp. 438–440.) Some practical transistor arrangements with and without diodes are described.

621.318.57: 621.382.3 58

Static Switching.—G. T. Ohlsen. (*Electronic Engng*, Oct. 1960, Vol. 32, No. 392, pp. 609–613.) A transistor NOR unit, (output only when all inputs absent) is shown to be suitable as a basic element for building switching systems.

621.372.4/.5 59

The Practical Significance for Communication Technique of the Relation between Hilbert Transformation and Harmonic Analysis.—G. Wunsch. (*Arch. elekt. Übertragung*, Dec. 1959, Vol. 13, No. 12, pp. 503–508.) Conformal mapping is used to show that the Hilbert transformation can be reduced to a harmonic analysis which would simplify attenuation and phase calculations. Practical methods of carrying out the transformation are outlined.

621.372.412 60

Vibration of Quartz Crystal Plates.—R. P. Jerrard. (*Quart. appl. Math.*, July 1960, Vol. 18, No. 2, pp. 173–181.) The theory of Mindlin (1861 of 1951) is extended to the case of crystal plates of nonuniform thickness.

621.372.412 61

Design and Performance of Ultraprecise 2·5-5-Mc/s Quartz Crystal Units.—A. W. Warner. (*Bell Syst. tech. J.*, Sept. 1960, Vol. 39, No. 5, pp. 1193–1217.) Techniques are described for producing crystal resonators with a frequency stability within about 1 part in 10^{10}, and a Q of $5–6 \times 10^6$. For periods up to 1 month the frequency stability compares favourably with that of atomic frequency standards.

621.372.412.002 62

On the Electrodes of 100 kc/s GT-Cut Crystal Units used for the Frequency Standards.—Y. Hiruta. (*J. Radio Res. Labs, Japan*, May 1960, Vol. 7, No. 31, pp. 245–261.) The physical properties and method of fabrication of electrodes for crystals used in primary frequency standards are described. A maximum Q is obtained when the gold-sputtered electrode has a thickness of 350–450 Å; advantages of annealing are discussed.

621.372.413 63

Temperature Compensation of Coaxial Cavities.—J. R. Cogdell, A. P. Deam & A. W. Straiton. (*Trans. Inst. Radio Engrs*, March 1960, Vol. MTT-8, No. 2, pp. 151–155.) Abstract, *Proc. Inst. Radio Engrs*, June 1960, Vol. 48, No. 6, Part 1, p. 1195.)

621.372.413: 621.317.763 64

Increasing the Frequency Stability of Homogeneous Cylindrical Cavity Resonators.—H. J. Oberg. (*Telefunken Ztg*, Dec. 1959, Vol. 32, No. 126, pp. 265–268. English summary, p. 293.) The effect of temperature fluctuations and atmospheric conditions on the resonator dimensions and the characteristics of the dielectric are investigated to determine means of minimizing frequency variations.

621.372.413: 621.372.8 65

How to Design Broadband Microwave Cavities.—A. Kiriloff. (*Electronics*, 14th Oct. 1960, Vol. 33, No. 42, pp. 96–100.) Design criteria for rhumbatrons of cylindrical and prismatic form are given with a numerical example for each type.

621.372.5 66

Analysis of All-Pass Networks: Part 1—General Remarks and Classification.—G. Wunsch. (*Hochfrequenztech. u. Elektroakust.*, Jan. 1960, Vol. 68, No. 6, pp. 169–176.)

621.372.5 67

The Theory of the Realization of Linear Quadripole Networks with Prescribed Effective Transfer Function in the Presence of Lossy Circuit Elements.—Nai-Ta Ming. (*Hochfrequenztech. u. Elektroakust.*, Jan. 1960, Vol. 68, No. 6, pp. 190–193.) Summary by the author of the results contained in a more extensive paper published in Chinese.

621.372.5 68

The Differences between Single and Periodic Transient Processes in Low-Pass Transmission Systems.—R. Elster & K. H. Steiner. (*Nachrichtentech. Z.*, Dec. 1959, Vol. 12, No. 12, pp. 618–624.) The differences are calculated for square pulse waveforms and ideal transmission systems; corrections can be made to obtain approximations applicable to practical low-pass networks.

621.372.51 69

Synthesis Techniques for Gain-Bandwidth Optimization in Passive Transducers.—H. J. Carlin. (*Proc. Inst. Radio Engrs*, Oct. 1960, Vol. 48, No. 10, pp. 1705–1714.) The technique produces from the idealized gain-bandwidth constraints, which ensure matching to a given load, a set of functions specifying the equalizer alone; the fixed transducer is synthesized from these functions. Examples illustrating the technique are given.

621.372.54 70

An Analogue Device for Problems of Filter Development.—W. Poschenrieder & H. Sonthelm. (*Frequenz*, Dec. 1959, Vol. 13, No. 12, pp. 379–385.) The equipment described is used for the design of filters from given operating characteristics. Other applications, such as filter correction and filter design for pulse waveforms are outlined.

621.372.54 71

Ladder Networks with Tchebycheff Characteristic.—M. Trinchieri. (*Alta Frequenza*, Oct.–Dec. 1959, Vol. 28, Nos. 5/6, pp. 541–578.) Ladder networks without poles are considered with Tchebycheff transfer function for inputs from a generator with finite internal impedance, or from ideal current or voltage generators. Design formulae are tabulated.

621.372.54 72

An Alternative Approach to the Realization of Network Transfer Functions: the n-Path Filter.—L. E. Franks & I. W. Sandberg. (*Bell Syst. tech. J.*, Sept. 1960, Vol. 39, No. 5, pp. 1321–1350.) A time-varying network consisting of n parallel transmission paths each containing input and output modulators, is described and analysed. Some practical applications are discussed in detail, and experimental verification is presented.

621.372.54: 621.316.825 73

Low-Frequency Wave Filters employing Thermistors.—R. A. Rasmussen. (*Rev. sci. Instrum.*, July 1960, Vol. 31, No. 7, pp. 747–751.) A general review of thermistor properties and small-signal performance is presented, together with results of measurements at very low frequencies and response curves of simple filter circuits.

621.372.54: 621.396.96 74

Realization of a Comb Filter for the Detection of Pulse Signals in Noise.—A. Garino. (*Note Recensioni Notiz.*, Jan./Feb. 1960, Vol. 9, No. 1, pp. 43–60.) The use of comb filters in radar systems is discussed, and the results obtained on an experimental filter system with up to seven pass bands are given.

621.372.542 75

The Correction of Phase Distortion in *RC* Networks near Cut-Off Frequency.—D. Gossel. (*Arch. elektr. Übertragung*, Dec. 1959, Vol. 13, No. 12, pp. 525–529.) Examples of phase-correcting networks and optimum design conditions are given.

621.372.543.2: 538.632 76

Mechanical Filters.—H. D. Pieper. (*Telefunken Ztg*, Dec. 1959, Vol. 32, No. 126, pp. 279–283. English summary, p. 294.) See also 2155 of 1959 (Börner et al.).

621.372.543.3: 621.372.55 77

Band-Stop Filters.—R. O. Rowlands. (*Electronic Technol.*, Nov. 1960, Vol. 37, No. 11, pp. 431–433.) "A method of achieving resistance compensation in band-stop filters is described. Performance curves and normalised component values are calculated for a 5-pole filter."

621.372.55 78

High Selectivity with Constant Phase over the Pass Band.—A. W. Ribaczek. (*Proc. Inst. Radio Engrs*, Oct. 1960, Vol. 48, No. 10, pp. 1756–1760.) A relatively simple frequency-inversion process is described for compensation of phase shifts in filters, resulting in a constant output signal phase.

621.372.6 79

Equivalent Networks of Generic Multipoles.—G. Biorci & L. Piglione. (*Alta Frequenza*, Oct.–Dec. 1959, Vol. 28, Nos. 5/6, pp. 528–540.) A nonreciprocal four-terminal network can be realized by an equivalent circuit which contains only one nonreciprocal three-pole element.

621.373.42.072.6: 621.385.62 80

A New Automatic Frequency Regulation System.—J. R. Singer. (*Trans. Inst. Radio Engrs*, March 1960, Vol. MTT-8, No. 2, p. 249.) Brief description of a system for stabilizing the output of a K-band klystron. The error signal is derived from a phase comparison of a 100-kc/s driving signal with the rectified microwave signal reflected from a dimension-modulated reference cavity. The resonance frequency of the cavity is controlled by a driven Rochelle-salt crystal.

621.373.42.072.7 81

Automatic Phase Control: Theory and Design.—T. J. Rey. (*Proc. Inst. Radio Engrs*, Oct. 1960, Vol. 48, No. 10, pp. 1760–1771.) Systems with a sinusoidal reference signal are analysed and the results verified experimentally.

621.373.44 82

Variable-Program Triggering Source.—B. E. Bourne. (*Electronics*, 9th Sept. 1960, Vol. 33, No. 37, pp. 76–77.) A transistorized unit for use with instrumentation cameras is described which generates pulses at an adjustable constant rate or at a rate which is variable for a selected period between predetermined initial and final rates.

621.373.444: 621.382.3 83

A Special Trigger Circuit.—C. Mira & Y. Sevely. (*C. R. Acad. Sci., Paris*, 18th Jan. 1960, Vol. 250, No. 3, pp. 488–490.) The bistable transistor circuit with common emitter resistance analysed earlier [1139 of 1960 (Mira)] has characteristics similar to those of the Schmitt multivibrator circuit. Two variations of the circuit component values are considered, corresponding to 'saturating' and 'nonsaturating' conditions.

621.374.3: 621.382.23 84

High-Speed Scalers using Tunnel Diodes.—P. Spiegel. (*Rev. sci. Instrum.*, July 1960, Vol. 31, No. 7, pp. 754–755.) A simple reliable scaler with resolving time < 50 ns is described.

621.374.4: 621.382.3 85

A Cascode Trigger Circuit using a *p-n-p* and *n-p-n* Transistor.—P. Arnoldt. (*Electronic Engng*, Oct. 1960, Vol. 32, No. 392, pp. 620–623.) A monostable circuit preceded by a diode-pump integrator acts as a frequency dividing stage.

621.374.5: 534.2-8-14 86

Variable Ultrasonic Water Delay Line.—G. W. Williams. (*Brit. J. appl. Phys.*, Aug. 1960, Vol. 11, No. 8, pp. 358–363.) The unit described produces a delay variable from 200–2 600 μs, and stable to within 0·05%; the bandwidth is 800 kc/s at 7 Mc/s.

621.375.1 87

The Noise Figure of Several Amplifiers in Cascade.—A. Ascione. (*Note Recensioni Notiz.*, Nov./Dec. 1959, Vol. 8, No. 6, pp. 620–630.)

621.375.9: [538.569.4 + 621.372.44 88

Parametric Devices and Masers: an Annotated Bibliography.—E. Mount & B. Begg. (*Trans. Inst. Radio Engrs*, March 1960, Vol. MTT-8, No. 2, pp. 222–243.)

621.375.9: 538.569.4: 621.374.42 89

Parametric Diodes in Maser Phase-Locked Frequency Divider.—M. L. Stitch, N. O. Robinson & W. Silvey. (*Trans. Inst. Radio Engrs*, March 1960, Vol. MTT-8, No. 2, pp. 218–221. Abstract, *Proc. Inst. Radio Engrs*, June 1960, Vol. 48, No. 6, Part 1, p. 1195.)

621.375.9: 621.372.44 90

Contribution to the Study of Parametric Amplifiers.—G. Marie & Y. Angel. (*C. R. Acad. Sci., Paris*, 11th Jan. 1960, Vol. 250, No. 2, pp. 311–313.) An analysis of parametric amplifier operation in terms of feedback loops. Expressions are derived for the insertion gain, noise temperature and bandwidth of different two- and three-frequency arrangements, which can be generalized for a four-frequency system.

621.375.9: 621.372.44 91

The Transmission of Signals of Any Form by means of a Degenerate Parametric Amplifier.—F. Bertein & A. Jelenski. (*C. R. Acad. Sci., Paris*, 4th Jan. 1960, Vol. 250, No. 1, pp. 88–90.) Formulae are derived for the response of a degenerate parametric amplifier comprising an antiresonant circuit with frequency-dependent admittance in parallel with a nonlinear-capacitance diode.

621.375.9: 621.372.44: 621.382.2 92

Theory of Diode Parametric Amplification.—F. Dachert. (*Ann. Radioélect.*, April 1960, Vol. 15, No. 60, pp. 109–119. English abridgment, pp. 200–201.)

621.375.9: 621.372.44: 621.382.23 93

The Reactance-Type Straight Amplifier as a Low-Noise Preamplifier Stage in the U.H.F. Range.—R. Maurer, K. H. Löcherer & K. Bomhardt. (*Arch. elektr. Übertragung*, Dec. 1959, Vol. 13, No. 12, pp. 509–524.) The signal and noise response of a cascade-connected amplifier is investigated which consists of a diode-reactance preamplifier [see 3426 of 1960 (Dahlke et al.)] followed by a conventional triode amplifier. Results are given of measurements on an experimental circuit using a signal frequency of 510 Mc/s with pumping at 1 800 Mc/s.

621.375.9: 621.372.44: 621.385.63 94

The D.C.-Pumped Quadrupole Amplifier—a Wave Analysis.—Siegman. (See 377.)

621.376.2 + 621.376.3 95

A Contribution to the Theory of the Transmission of Amplitude-Modulated, Frequency-Modulated or Amplitude- and Frequency-Modulated Carriers in Linear Systems: Part I.—E. Augustin. (*Hochfrequenztech. u. Elektroakust.*, Jan. 1960, Vol. 68, No. 6, pp. 177–185.) The standard method of calculating the distortion of f.m. signals in linear systems, which is based on an asymptotic series, is critically reviewed and its limitations are considered.

GENERAL PHYSICS

535.215 96

Photovoltaic Effect Derived from the Carnot Cycle.—A. Rose. (*J. appl. Phys.*, Sept. 1960, Vol. 31, No. 9, pp. 1640–1641.) An expression for the maximum power derivable from any photovoltaic device is developed in terms of the incident light intensity measured in units of black-body radiation.

537.29: 537.56 97

Velocity Distribution of Electrons in a Strong Electric Field.—L. M. Kovrizhnykh. (*Zh. eksp. teor. Fiz.*, Nov. 1959, Vol. 37, No. 5 (11), pp. 1394–1400.) A method is developed for determination of a nonstationary solution of the Boltzmann equation in the case of strong electric fields.

537.29: 621.385.032.212 98

Field Emission through Dielectric Layers.—R. Gomer. (*Aust. J. Phys.*, July 1960, Vol. 13, No. 2A, pp. 391–401.) A summary is given of the results of field emission experiments on the adsorption of inert gases on tungsten, and a mechanism is described accounting for some of the phenomena encountered.

537.311.33 **99**

The Spatial- and Time-Fluctuation of Coulomb Energy in the Low-Concentration Impurity Conduction.—Y. Toyozawa. (*Prog. theor. Phys.*, Feb. 1960, Vol. 23, No. 2, pp. 380–382.) See 223 below.

537.312.8 **100**

Electron Scattering in High Magnetic Field.—A. H. Kahn. (*Phys. Rev.*, 15th Aug. 1960, Vol. 119, No. 4, pp. 1189–1192.) Electrical conductivity in a strong magnetic field is calculated for the case of scattering by delta-function impurities. Collision broadening is neglected and the scattering by an individual centre is solved exactly rather than by perturbation theory.

537.52 **101**

Microwave Breakdown of Air in Nonuniform Electric Fields.—F. M. Pinsonno & E. H. Holt. (*Phys. Rev.*, 15th Aug. 1960, Vol. 119, No. 4, pp. 1143–1149.) Two cases are treated theoretically: a rectangular microwave cavity and a cylindrical cavity with a hemispherical bump on one of its walls. The theoretical predictions are compared with breakdown measurements in air.

537.52 : 551.510.52 **102**

High-Frequency Breakdown of Air.—D. Kelly & H. Margenau. (*J. appl. Phys.*, Sept. 1960, Vol. 31, No. 9, pp. 1617–1620.) Kinetic theory is applied to the ionization breakdown of air surrounding an aerial on a high-speed vehicle. Breakdown-voltage/altitude curves are given for 225 Mc/s, 1 Gc/s and 10 Gc/s.

537.56 **103**

Electrical and Thermal Currents in a Slightly Ionized Gas.—M. S. Sodha. (*Phys. Rev.*, 1st Aug. 1960, Vol. 119, No. 3, pp. 882–886.) A general solution is given of the Boltzmann transfer equation for electrons under the influence of a.c. and d.c. electric fields, a magnetic field and a temperature gradient.

537.56 : 538.56 **104**

Nonlinear Effects on Electron-Plasma Oscillations.—M. Sumi. (*J. phys. Soc. Japan*, June 1960, Vol. 15, No. 6, pp. 1086–1093.) A nonlinear term in the Boltzmann equation is considered as a perturbation and the results are examined to investigate the validity of the linear approximation.

537.56 : 538.56 **105**

Forces on Charged Particles of a Plasma in a Cavity Resonator.—J. W. Gallop, T. L. Dutt & H. Gibson. (*Nature, Lond.*, 29th Oct. 1960, Vol. 188, No. 4748, pp. 297–298.) Two types of confining force are considered; (*a*) the 'Mathieu' force due to the electric field acting directly on electrons [see Boot et al. (3411 of 1958)], and (*b*) the e.m. force resulting from the interaction of the electron current with the magnetic field component of the e.m. wave.

537.56 : 538.56 **106**

Radio-Frequency Forced Oscillations in Nonuniform Plasmas.—R. B. R. Shersby-Harvie. (*J. Electronics Control*, June 1960, Vol. 8, No. 6, pp. 421–430.) A theory of periodic r.f. oscillations in a plasma is given neglecting electron-ion collisions and temperature variations. Small-signal approximations are derived which are applicable to plasma confinement problems.

537.56 : 538.569.4 **107**

Plasma Resonance in a Radio-Frequency Probe.—K. Takayama, H. Ikegami & S. Miyazaki. (*Phys. Rev. Lett.* 15th Sept. 1960, Vol. 5, No. 6, pp. 238–240.) Measurements of the d.c. component of the electron current to the probe show a resonance increase at the electron plasma frequency.

537.56 : 538.63 **108**

Negative Electrical Conductivities.—J. Sobrovsky. (*Z. Naturf.*, May/June 1960, Vol. 15a, Nos. 5/6, pp. 404–409.) The complex electrical h.f. conductivity σ of a plasma in a magnetic field is calculated on the basis of Boltzmann's equation, and the occurrence of negative values of the real part of σ is discussed.

537.56 : 538.63 **109**

Oscillations in a Plasma in a Weak Magnetic Field.—K. Kato. (*J. phys. Soc. Japan*, June 1960, Vol. 15, No. 6, pp. 1099–1101.) Oscillations of two types were observed in a discharge tube. These are interpreted as the plasma-type oscillation and the cyclotron-resonance oscillation.

537.56 : 538.63 **110**

Oscillations of an Inhomogeneous Plasma in a Magnetic Field.—L. I. Rudakov & R. Z. Sagdeev. (*Dk. akad. nauk SSSR*, Nov. 1959, Vol. 37, No. 5/11, pp. 1337–1341.) Mathematical analysis of small oscillations of a hot plasma confined by a magnetic field shows that there are two types of wave: (*a*) a slow drift wave, characteristic of an inhomogeneous plasma, and (*b*) a magneto-acoustic wave. If certain relations obtain, the drift current can cause amplification of the oscillations; criteria for an instability of this kind are derived.

537.56 : 538.63 **111**

Transport Properties of Plasma in a Strong Magnetic Field.—T. Kihara, Y. Midzuno & S. Kaneko. (*J. phys. Soc. Japan*, June 1960, Vol. 15, No. 6, pp. 1101–1107.)

537.56 : 538.63 **112**

Compression Waves in a Plasma in a Static Magnetic Field.—N. Anderson. (*Proc. phys. Soc.*, 1st June 1960, Vol. 75, No. 486, pp. 905–912.)

537.56 : 551.510.535 **113**

Ion Charge Exchange Reactions in Oxygen Afterglows.—F. H. G. Dickinson & J. Sayers. (*Proc. phys. Soc.*, 1st July 1960, Vol. 76, No. 487, pp. 137–148.) Measurements made by a linear-accelerator mass spectrometer of the decay of O^+ ion concentration after a pulsed discharge are discussed with reference to electron loss processes in the upper ionosphere.

538.221 : 061.3 **114**

Summarized Proceedings of a Conference on Some Aspects of Magnetism, Sheffield, September 1959.—R. S. Tebble & D. E. G. Williams. (*Brit. J. appl. Phys.*, Aug. 1960, Vol. 11, No. 8, pp. 307–313.)

538.221 : 538.569.4 **115**

Generation of Phonons in High-Power Ferromagnetic-Resonance Experiments.—E. Schlömann. (*J. appl. Phys.*, Sept. 1960, Vol. 31, No. 9, pp. 1647–1656.) Magneto-elastic waves are produced by coupling between spin waves and elastic vibrations.

538.221 : 621.318.134 : 535.37 **116**

Combinational Scattering of Electromagnetic Waves in Ferromagnetic Dielectrics.—F. G. Bass & M. I. Kaganov. (*Dk. akad. nauk SSSR*, Nov. 1959, Vol. 37, No. 5/11, pp. 1089–1092.) Raman-type scattering by oscillations of the magnetic moment is predicted. The extinction coefficient for the scattered radiation is calculated.

538.3 **117**

The Influence of the Conductivity of the Surrounding Medium on the Inductance of a Current Loop.—S. V. Zernitskii & M. N. Uzhegov. (*Zh. tekh. Fiz.*, Aug. 1960, Vol. 30, No. 8, pp. 1005–1013.) Using Fourier's solution for the field of a low-frequency current element lying on the surface of a conducting medium, the input impedance of a current loop is calculated by the method of induced e.m.f.'s.

538.321 : 621.3.013.78 **118**

Shielding of Transient Electromagnetic Signals by a Thin Conducting Sheet.—S. R. Cohen. (*J. Res. nat. Bur. Stand., Sect. D*, Nov.–Dec. 1960, Vol. 64D, No. 6, pp. 505–507.) The screening effects of an imperfectly conducting sheet against the transient field of a vertical magnetic dipole with a complementary excitation are investigated.

538.361 : 537.533 **119**

Magnetic Electrostatic Converter Coupler for the Production of Millimetre and Submillimetre Waves.—P. D. Coleman & C. Enderby. (*J. appl. Phys.*, Sept. 1960, Vol. 31, No. 9, pp. 1695–1696.) Cherenkov radiation at the next level can be produced and beamed by passing a high-harmonic 1-MeV electron beam through a 8-mm hole in a large specially shaped teflon cone. The measured radiated power shows good agreement with theory.

538.561 : 539.142 : 537.36 **120**

Field of a Charged Particle in a Moving Medium.—B. M. Bolotovskii & A. A. Rukhadze. (*Zh. eksp. teor. Fiz.*, Nov. 1959, Vol. 37, No. 5/11, pp. 1346–1351.) Energy losses of the charge due to Cherenkov radiation and excitation of plasma waves are determined.

538.566 **121**

Wide-Band Absorbers for Electromagnetic Waves.—J. Deutsch & P. Thust. (*Z. angew. Phys.*, Dec. 1959, Vol. 11, No. 12, pp. 453–455.) The construction is described of shaft-type absorbers suitable for metre waves. Measurements of reflection coefficient as a function of frequency and angle of incidence are discussed, and the

possibilities of reducing the depth of the absorber and of extending the absorption range to lower frequencies are mentioned.

538.566: 535.42 **112**

The Diffraction of Electromagnetic Waves by a Circular Cylinder in a Homogeneous Half-Space.—B. P. D'yakonov. (*Izv. Ak. Nauk S.S.S.R., Ser. geofiz.*, Sept. 1959, No. 9, pp. 1332–1343.) A solution is obtained for the diffraction by a cylindrical inhomogeneity below the surface of the earth of an e.m. field produced by a point source.

538.566: 535.43: 537.56 **113**

Scattering of Electromagnetic Waves from an Infinitely Long Magnetized Cylindrical Plasma.—[illegible]

538.566: 535.42: 537.56 **114**

Scattering of Radiation by a Plasma.—[illegible]

538.566: 537.56 **115**

On Electromagnetic Oscillations in Magneto-ionic Media.—[illegible]

538.566: 537.56 **116**

Quantum Effect in an Electron Plasma in a Magnetic Field.—[illegible]

538.566.029.6: 537.56 **117**

Propagation of Microwaves through a Magnetosphere, and a possible Method for Determining the Electron Velocity Distribution.—[illegible]

538.569.2 **118**

Boundary Conditions and Skin-Layers in Conducting Wedges.—[illegible]

538.569.4 **119**

Modulation-Effect Corrections for Measures of Magnetic-Resonance Line Shapes.—[illegible]

550.031 **120**

Electromagnetic Pressure on a Charge Moving in a Magnetic Field.—Ya. B. Faînberg & V. I. Kurilko. (*Zh. tekh. Fiz.*, Aug. 1959, Vol. 29, No. 8, pp. 939–945.) The radiation pressure on *an oscillating particle is considerably greater* than that on a free charge. The problem is considered in a nonlinear approximation and the equations of motion are discussed.

550.2: 538.1 **121**

Spin Configurations.—F. Bertaut. (*C. R. Acad. Sci., Paris*, 6th Jan. 1960, Vol. 250, No. 1, pp. 85–87.) A direct and a Fourier method are outlined for determining the configurations of ordered spin arrangements.

[illegible]

523.16 **122**

On Electric Charges on Solar Corpuscles and Neutral Hydrogen Atoms.—[illegible]

523.746 **123**

The Spectrum of the Cygnus (19N4A) and Cassiopeia (23N5A) Radio Sources below 20 Mc/s.—[illegible]

523.746: 621.396.677 **124**

The New Radio Astronomy Center of the University of Tokyo.—[illegible]

523.164.3 **125**

Radio Detection of the Planet Saturn.—J. J. Cook, L. G. Cross, M. E. Bair & C. R. Arnold. (*Nature, Lond.*, 29th Oct. 1960, Vol. 188, No. 4748, pp. 393–394.) Brief report of the detection of 7·45-cm radiation from Saturn, using an N-band ruby maser in a modified Dicke-type radiometer system installed on an 85-ft paraboloid. A preliminary temperature of 0·085 ± 0·02°K was obtained indicating an equivalent black-body disk temperature of 150 ± 15°K.

523.164.3 **126**

Observed Variations in the Amplitude Scintillations of the Cassiopeia (23N5A) Radio Source.—H. J. A. Chivers. (*J. atmos. terr. Phys.*, Sept. 1960, Vol. 18, No. 1, pp. 54–64.) Observations over a period of four years are analysed. Daily variations are presented as functions of solar and sidereal time, and the effect of the solar cycle is studied.

523.164.3: 621.391.812.6 **127**

Anomalous Winter Absorption of Radio Waves.—R. W. Morris. (*Proc. phys. Soc.*, 1st June 1960, Vol. 75, No. 486, pp. 937–939.) Measurements made at Cambridge, England, of the absorption of cosmic radio noise on a frequency of 24·3 Mc/s show that the average midday absorption in winter is about twice as great as in summer. An attempt is made to relate this abnormality to the winter anomaly in absorption of reflected waves. If certain assumptions are made it can be shown that on the majority of days in winter the absorbing electrons are largely confined to a height of about 85 km.

523.165 **128**

Ionized Gas and Gas-Entrapped Electrons in the Vicinity of the Earth and in the Interplanetary Space.—[illegible]

523.165 **129**

Calculations of Cosmic-Ray Trajectories near the Equator.—P. J. Stoffregen. (*J. geophys. Res.*, Sept. 1960, Vol. 65, No. 9, pp. 2701–2703.)

523.165 **130**

Structure of the Van Allen Radiation.—P. J. Stoffregen. (*J. geophys. Res.*, Sept. 1960, Vol. 65, No. 9, pp. 2705–2713.) [illegible]

523.165 **131**

Sunlit Reflection of Cosmic-Ray Protons Measured in Interplanetary Space.—[illegible]

523.165: 523.746 **132**

Solar Cosmic Rays and Soft Radiation Observed at 1 000 000 Kilometres from Earth.—R. L. Arnoldy, R. A. Hoffman & J. R. Winckler. (*J. geophys. Res.*, Sept. 1960, Vol. 65, No. 9, pp. 3008–3007.) A summary of the cosmic-ray and soft-radiation effects observed during March/April 1960 using a space probe and ground observations.

523.165: 523.75 **133**

Observations of Solar Cosmic Rays near the North Magnetic Pole.—K. A. Anderson & D. C. Enemark. (*J. geophys. Res.*, Sept. 1960, Vol. 65, No. 9, pp. 2657–2671.)

523.165: 523.75 **144**

Comparison of Solar Cosmic Rays Injection including July 17, 1959, and May 4, 1960.—K. G. McCracken & R. A. R. Palmeira. (*J. geophys. Res.*, Sept. 1960, Vol. 65, No. 9, pp. 2673–2683.)

523.165: 523.75 **145**

Observations of Solar Flare Radiation and Modulation Effects at Balloon Altitudes, July 1959.—A. Ehmert, H. Erbe, G. Pfotzer, C. D. Anger & R. R. Brown. (*J. geophys. Res.*, Sept. 1960, Vol. 65, No. 9, pp. 2685–2694.)

523.165: 523.75 **146**

Propagation of Low Energy Cosmic Ray Particles associated with Solar Flares.—K. Sakurai. (*J. Geomag. Geoelect.*, 1960, Vol. 11, No. 4, pp. 152–164.) The propagation mechanism is examined using data obtained during the period June 1957–May 1959.

523.165: 538.12 **147**

Cosmic-Ray Intensity Variations and the Interplanetary Magnetic Field.—H. Elliot. (*Phil. Mag.*, June 1960, Vol. 5, No. 54, pp. 601–619.) The characteristics of the variations can be explained in terms of a dipole type of field generated by current systems in the solar corona.

523.165: 550.385.4 **148**

Low-Energy Solar Cosmic Rays and the Geomagnetic Storm of May 12, 1959.—J. R. Winckler & P. D. Bhavsar. (*J. geophys. Res.*, Sept. 1960, Vol. 65, No. 9, pp. 2637–2655.)

523.165: 550.385.4 **149**

The Effect of the Initial Phase of a Magnetic Storm upon the Outer Van Allen Belt.—J. M. Malville. (*J. geophys. Res.*, Sept. 1960, Vol. 65, No. 9, pp. 3008–3010.) A theoretical study of the motion of a charged particle trapped in a magnetic dipole field and in a compressed dipole field. The latitude shift of the trapped radiation during magnetic storms is found to be small.

523.165: 551.507.362.1 **150**

Experiments on the Eleven-Year Changes of Cosmic-Ray Intensity using a Space Probe.—C. Y. Fan, P. Meyer & J. A. Simpson (*Phys. Rev. Lett.*, 15th Sept. 1960, Vol. 5, No. 6, pp. 272–274.) It is shown that the mechanism responsible for the changes is heliocentric and the region in which the changes occur is located principally outside the earth's orbit.

523.165: 551.507.362.1 **151**

Investigation of Interplanetary Ionized Gas, High-Energy Electrons and Solar Corpuscular Radiation by means of Three-Electrode Traps for Charge-Carrying Particles Installed on the Second Soviet Space Rocket.—K. I. Gringauz, V. V. Bezrukikh, V. D. Ozerov & R. E. Rybchinskiĭ. (*Dokl. Ak. Nauk S.S.S.R.*, 21st April 1960, Vol. 131, No. 6, pp. 1301–1304.) Between 55 000 and 75 000 km from the earth electron streams of 10^8 electrons/cm².sec and energies >200 eV were recorded. Protons with energies of 25 eV at heights of 125 000 km were also noted.

523.165: 551.507.362.2 **152**

Development of Multiple Radiation Zones on October 18th, 1959.—B. J. O'Brien & G. H. Ludwig. (*J. geophys. Res.*, Sept. 1960, Vol. 65, No. 9, pp. 2695–2699.) Present observations made at about 1000 km altitude during a magnetic storm using counters carried on Explorer VII.

523.165: 551.507.362.2 **153**

Outer Radiation Belt and Solar Proton Observations with Explorer VII during March–April 1960.—J. A. Van Allen & W. C. Lin. (*J. geophys. Res.*, Sept. 1960, Vol. 65, No. 9, pp. 2998–3003.) A preliminary summary of observed counting rates which includes rate/time plots for typical passes. Some of the fluctuations in the outer belt during the observation period are referred to briefly.

523.165: 551.507.362.2 **154**

Detection of 10-keV Electrons in the Upper Atmosphere by the Third Earth Satellite.—V. I. Krasovskiĭ, I. S. Shklovskiĭ, Yu. I. Gal'perin & E. M. Svetlitskiĭ. (*Izv. Ak. Nauk S.S.S.R., Ser. geofiz.*, Aug. 1959, No. 8, pp. 1157–1163.) Electrons of energies 10–40 keV were detected by means of two fluorescent screens covered with thin Al foil of different thickness used in conjunction with photomultipliers. The flux increases sharply with decreasing energy. At high latitudes the night-time energy flux reaches a few tens of ergs/cm².sec. sterad.

523.165: 551.510.535 **155**

Penetration of Fast Charged Particles from the Outer Atmosphere into the Ionosphere.—V. D. Pletnev. (*Izv. Ak. Nauk S.S.S.R., Ser. geofiz.*, Aug. 1959, No. 8, pp. 1164–1166.) In streams of oscillating particles trapped in the earth's magnetic field, the directions of motion will show pronounced spatial anisotropy due to absorption effects in the lower layers of the atmosphere.

523.165: 551.594.5 **156**

The Outer Radiation Belt and Aurorae.—H. Liemohn. (*Nature, Lond.*, 29th Oct. 1960, Vol. 188, No. 4748, pp. 394–395.) Space probe observations are found to be in good agreement with a proposed unsymmetric model for the outer radiation belt. See also 4063 of 1959 (Rees & Reid).

523.165: 551.594.5 **157**

Correlation of an Auroral Arc and a Subvisible Monochromatic 6300-Å Arc with Outer-Zone Radiation on November 28, 1959.—B. J. O'Brien, J. A. Van Allen, F. E. Roach & C. W. Gartlein. (*J. geophys. Res.*, Sept. 1960, Vol. 65, No. 9, pp. 2759–2766.)

523.53: 621.396.96 **158**

A Southern Hemisphere Survey of the Radiants of Sporadic Meteors.—A. A. Weiss & J. W. Smith. (*Mon. Not. R. astr. Soc.*, 1960, Vol. 121, No. 1, pp. 5–16.) Results are given of a new survey with higher resolution equipment [see 4208 of 1960 (Weiss)] than that used for the earlier survey [109 of 1958 (Weiss)]. Good agreement is found with the results obtained by Hawkins in the northern hemisphere (2119 of 1957.)

525.35: 523.745: 529.786 **159**

Effect of the Solar Activity on the Earth's Rotation.—H. Uyeda, Y. Saburi & H. Iwasaki. (*J. Radio Res. Labs, Japan*, May 1960, Vol. 7, No. 31, pp. 131–136.) A linear relation is shown to exist between sunspot activity and $\frac{d}{dt}$ (CST−U.T.2) where CST is atomic time. This result is discussed in relation to the influence of solar activity on variations in the speed of rotation of the earth on its axis.

550.37 **160**

The Structure of the Electrostatic Field in the Free Atmosphere from the Evidence Obtained during International Geophysical Year Investigations.—I. M. Imyanitov & E. V. Chubarina. (*Dokl. Ak. Nauk S.S.S.R.*, 1st May 1960, Vol. 132, No. 1, pp. 104–107.) An examination of the spherical-capacitor hypothesis with reference to the variation of the electric potential with height and time of day.

550.37 **161**

Measurement of the Atmospheric Electric Field in the Free Atmosphere.—R. Mühleisen & H. J. Fischer. (*Naturwissenschaften*, Jan. 1960, Vol. 47, No. 2, pp. 36–37.) The results of radiosonde measurements up to about 30 km height are compared with measured and calculated field-strength data of other authors.

550.385.4 **162**

Geomagnetic-Storm Sudden-Commencement Rise Times.—A. J. Dessler, W. E. Francis & E. N. Parker. (*J. geophys. Res.*, Sept. 1960, Vol. 65, No. 9, pp. 2715–2719.) If the 'sudden commencement' of a magnetic storm is interpreted as the impact of a solar plasma 'front' on the geomagnetic field, its rise time, usually a few minutes, depends on the different transit times of hydromagnetic waves propagated to the earth's surface from different points on the boundary of the field.

550.385.4 **163**

A Note on Harmonic Analysis of Geophysical Data with Special Reference to the Analysis of Geomagnetic Storms.—M. Sugiura. (*J. geophys. Res.*, Sept. 1960, Vol. 65, No. 9, pp. 2721–2725.) The effect of the earth's rotation on the determination of magnetic disturbance variations DS and Dst is discussed.

551.507.362.1 **164**

Radio-Astronomy Observations of the Second Soviet Space Rocket.—V. V. Vitkevich, A. D. Kuz'min, R. L. Sorochenko & V. A. Udal'tsov. (*Dokl. Ak. Nauk S.S.S.R.*, 1st May 1960, Vol. 132, No. 1, pp. 85–88.) A report of observations of radio signals from the rocket which reached the moon at 0h 02 min 21 ± 1 sec on 14th September 1959. Signal intensity measurements were made using an interferometer technique.

551.507.362.2 **165**

On Mr. King-Hele's Theory of the Effect of the Earth's Oblateness on the Orbit of a Close Satellite.—P. J. Message, (*Mon. Not. R. astr. Soc.*, 1960, Vol. 121. No. 1, pp. 1–4.) An examination of the

relations between parameters used by King-Hele (2233 of 1959) and the more usual osculating orbital elements.

551.507.362.2 **166**

On the Motion of a Satellite in an Asymmetrical Gravitational Field.—P. Musen. (*J. geophys. Res.*, Sept. 1960, Vol. 65, No. 9, pp. 2783–2792.) A theory for the inclusion of the effects of tesseral harmonics in the motion.

551.507.362.2 **167**

Angular Motion of the Spin Axis of the Tiros I Meteorological Satellite due to Magnetic and Gravitational Torques.—W. R. Bandeen & W. P. Manger. (*J. geophys. Res.*, Sept. 1960, Vol. 65, No. 9, pp. 2992–2995.) The equations of motion including the two torques have been solved and the calculated and observed directions of the spin axis are in close agreement.

551.507.362.2: 531.3 **168**

Perturbations in Classical Mechanics.—L. M. Garrido. (*Proc. phys. Soc.*, 1st July 1960, Vol. 76, No. 487, pp. 33–35.) A method similar to quantum-mechanics time-dependent perturbation theory is described which might be useful in the calculation of satellite orbits and plasma stability.

551.507.362.2: 551.576 **169**

U.S. Meteorological Satellite Cameras photograph Cloud Cover.—(*Science*, 8th April 1960, Vol. 131, No. 3406, pp. 1031–1033.) Description of the Tiros I (1960/β2) satellite and associated tracking and interrogation equipment (see also 629 of 1960), and report on its launching and initial orbits.

551.507.362.2: 621.396.96 **170**

Weather Radar Observations from an Earth Satellite.—J. E. Keigler & L. Krawitz. (*J. geophys. Res.*, Sept. 1960, Vol. 65, No. 9, pp. 2793–2808.) A survey of the problems involved in designing a weather satellite. The use of radar in the satellite is discussed and also the problem of handling the data on the ground and in the satellite.

551.510.53: 621.384.8 **171**

A Method for Measuring Temperature Directly in the Upper Atmosphere with a Rocket-Borne Magnetic Mass Spectrometer.—C. Y. Johnson, J. H. Hoffman, J. M. Young & J. C. Holmes. (*J. geophys. Res.*, Sept. 1960, Vol. 65, No. 9, pp. 2996–2997.) Gas temperature is determined from the variation of the flux of neutral particles entering the instrument.

551.510.535 **172**

On the Problem of an Effective Recombination Coefficient in the Ionosphere.—B. A. Bagaryatskiĭ. (*Izv. Ak. Nauk S.S.S.R., Ser. geofiz.*, Sept. 1959, No. 9, pp. 1359–1363.) Discussion of possible chemical exchange reactions operative in establishing ion balance in the ionosphere.

551.510.535 **173**

Changes f_{min} at Kokubunji, Tokyo.—H. Hojo. (*J. Radio Res. Labs, Japan*, May 1960, Vol. 7, No. 31, pp. 213–243.) A statistical analysis of f_{min} data recorded during the period 1946–1958 and a study of their relation to ionospheric absorption, atmospheric noise and other geophysical effects.

551.510.535 **174**

A Statistical Theory of Ionospheric Drifts.—J. P. Dougherty. (*Phil. Mag.*, June 1960, Vol. 5, No. 54, pp. 553–570.) A statistical study of the fluctuations in plasma density is used in an attempt to interpret drift velocities. It is assumed that the ionization is transported by a turbulent flow in the neutral air under the action of the magnetic field and the dynamo electric field. The application of the theory to different heights in the ionosphere is examined.

551.510.535 **175**

Observations of Sudden Ionospheric Disturbances.—R. W. Morriss. (*Proc. phys. Soc.*, 1st July 1960, Vol. 76, No. 487, pp. 79–92.) Observed phase changes for reflected waves of frequency 2–6 Mc/s are possible due to an increase in electron density, extending to above the E-layer maximum. Measurements of the absorption of cosmic noise transmitted through the ionosphere show that an increase occurs at heights as low as 65 km or even 50 km.

551.510.535 **176**

Use of the Incoherent Scatter Technique to Obtain Ionospheric Temperatures.—T. E. VanZandt & K. L. Bowles. (*J. geophys. Res.*, Sept. 1960, Vol. 65, No. 9, pp. 2627–2628.) If the ionization above the F_2 peak is in diffusive equilibrium, its density decreases exponentially with height, with a scale height proportional to the temperature of the neutral gas. Electron-density profiles obtained by the incoherent scatter method at 41 Mc/s are consistent with a temperature of about 1 000 K between 370 km and 520 km.

551.510.535 **177**

F-Region Travelling Disturbances and Sporadic-E Ionization.—L. H. Heisler & J. D. Whitehead. (*J. geophys. Res.*, Sept. 1960, Vol. 65, No. 9, pp. 2767–2773.) A statistical study shows an association between F-region travelling disturbances and increases in E_s ionization at Sydney. For about one disturbance in 15, f_0E_s increases by approximately 1 Mc/s in some 13 min after the appearance of the disturbance and returns to normal 12 min later.

551.510.535 **178**

Damping Coefficient of Vibrating Electrons.—V. Marasigan. (*J. atmos. terr. Phys.*, Sept. 1960, Vol. 19, No. 1, pp. 65–67.) "A Druyvesteyn distribution is substituted for the assumed Maxwellian distribution in the derivation of the damping coefficient of vibrating electrons. The consequences are discussed."

551.510.535 **179**

Formation of the Sporadic E Layer in the Temperate Zones.—J. D. Whitehead. (*Nature, Lond.*, 12th Nov. 1960, Vol. 188, No. 4750, p. 567.) An extension of work described earlier [3501 of 1960 (Heisler & Whitehead)] to include regions where the gyro-frequency of the ions is less than their collision frequency.

551.510.535: 523.164 **180**

Further Observations of Radio Stellar Scintillation.—I. L. Jones. (*J. atmos. terr. Phys.*, Sept. 1960, Vol. 19, No. 1, pp. 26–36.) Results are described which support those of Spencer (121 of 1956) concerning the elongation of ionospheric irregularities. The size of the irregularities is estimated and a change in dimensions with elevation of the radio source is observed.

551.510.535: 551.507.362.1 **181**

Electron-Density Distribution in the Upper Ionosphere from Rocket Measurements.—J. S. Nisbet. (*J. geophys. Res.*, Sept. 1960, Vol. 65, No. 9, pp. 2597–2599.) Seven flights between 1956 and 1959 having maximum heights of 400–800 km are discussed. The electron distribution above the F_2-layer maximum agrees well with that given by Chapman theory.

551.510.535: 551.507.362.2 **182**

A Variable Atmospheric-Density Model from Satellite Accelerations.—L. G. Jacchia. (*J. geophys. Res.*, Sept. 1960, Vol. 65, No. 9, pp. 2775–2782.) An empirical expression is derived which relates atmospheric density ρ and scale height H to satellite orbital elements and 20-cm solar r.f. noise flux F. From this ρ can be obtained as a function of F, height h and solar zenith angle ψ. Tables of H, ρ and $\rho H^{1/2}$ are given for $h = 200$–700 km and for two values of F and ψ.

551.510.535: 551.507.362.2 **183**

The Determination of Ionospheric Electron Content from Satellite Doppler Measurements: Part 1—Method of Analysis.—W. J. Ross. (*J. geophys. Res.*, Sept. 1960, Vol. 65, No. 9, pp. 2601–2606.) Theory is given which is based on measurements of the slopes of the differential Doppler and the Doppler curves obtained from observations of the transmission at 20 and 40 Mc/s from Sputnik III. A semi-empirical formula is derived for the total electron content.

551.510.535: 551.507.362.2 **184**

The Determination of Ionospheric Electron Content from Satellite Doppler Measurements: Part 2—Experimental Results.—W. J. Ross. (*J. geophys. Res.*, Sept. 1960, Vol. 65, No. 9, pp. 2607–2615.) The results of observations made from September 1958 to December 1959 are presented. A winter to summer variation of 2·5: 1 in total midday electron content was observed. The diurnal variation showed an increasing content towards evening although the content below h_{max} was decreasing. Day-to-day variations correlated well with $1/K_p$ during the summer.

551.510.535: 551.507.362.2 **185**

The Electron Content and Distribution in the Ionosphere.—T. G. Hame & W. D. Stuart. (*Proc. Inst. Radio Engrs*, Oct. 1960, Vol. 48, No 10, pp. 1786–1787.) Addendum to 2009 of 1960.

551.510.535: 621.391.812.63 **186**

Use of Logarithmic Frequency Spacing in Ionogram Analysis.—G. A. M. King. (*J. Res. nat. Bur. Stand.*, Sept./Oct. 1960, Vol. 64D, No. 5, pp. 501–504.) An improved method for the reduction of ionograms to electron-density profiles.

551.510.535: 621.391.812.63 **187**
: 621.3.087.4

An Improved Automatic Method for Measurement of Ionospheric Absorption.—L. Thomas. (*Electronic Engng*, Oct. 1960, Vol. 32, No. 392, pp. 635–639.) Pulses are transmitted at vertical incidence at a rate of one per second and the mean echo amplitude over an interval of about one minute is recorded.

551.510.535: 621.391.812.63.029.63 **188**

Some Characteristics of Ionospheric Back-Scatter Observed at 440 Mc/s.—V. C. Pineo, L. G. Kraft & H. W. Briscoe. (*J. geophys. Res.*, Sept. 1960, Vol. 65, No. 9, pp. 2629–2633.) An investigation of the E and F layers by the incoherent back-scatter technique, using either vertical or oblique incidence is described. The spectra of radiation scattered from different heights, and an electron-density profile from 200 km to 700 km, are shown.

551.510.535: 621.396.96: 523.3 **189**

Faraday Rotation Observations of the Electron Content of the Exosphere.—R. B. Dyce. (*J. geophys. Res.*, Sept. 1960, Vol. 65, No. 9, pp. 2617–2618.) The moon-echo observations of various workers are summarized. The ratios obtained for the ionospheric electron content above h_{max} to that below are tabulated.

551.510.535: 621.396.96: 523.3 **190**

Radar-Lunar Investigations at a Low Geomagnetic Latitude.—G. H. Millman, A. E. Sanders & R. A. Mather. (*J. geophys. Res.*, Sept. 1960, Vol. 65, No. 9, pp. 2619–2626.) The theory and results are presented for polarization rotation observations of pulsed radar transmissions at 400 Mc/s reflected from the moon. The diurnal variation of total electron content of the ionosphere is shown.

551.510.536: 061.3 **191**

Symposium on the Exosphere and Upper F Region.—(*J. geophys. Res.*, Sept. 1960, Vol. 65, No. 9, pp. 2563–2636.) The text is given of papers presented at the symposium held in Washington, D.C., 4th May 1960. Some of the papers are abstracted separately, others are listed below.

(*a*) The Exosphere and Upper F Region.—F. S. Johnson (pp. 2571–2575.)

(*b*) Structure of the Earth's Exosphere.—S. F. Singer (pp. 2577–2580.)

(*c*) Whistler Dispersion and Exospheric Hydrogen Ions.—R. E. Barrington & T. Nishizaki (pp. 2581–2582.)

(*d*) Electron Densities to 5 Earth Radii deduced from Nose Whistlers.—R. L. Smith & R. A. Helliwell (p. 2583.)

(*e*) Comment on Models of the Ionosphere above $h_{max}F_2$.—J. W. Wright (pp. 2595–2596.)

(*f*) Radio-Wave Scattering by an Ionized Gas in Thermal Equilibrium.—J. A. Fejer (pp. 2635–2636.)

551.510.536: 551.507.362.1 **192**

A Sounding Rocket Measurement of Electron Densities to 1500 Kilometres.—W. W. Berning. (*J. geophys. Res.*, Sept. 1960, Vol. 65, No. 9, pp. 2589–2594.) Doppler measurements were made at 37 and 148 Mc/s. Above the F_2-layer peak, the electron-density decrease indicates a scale height of 30 km at 270 km, and a linear gradient in scale height of 0·45 from 270 to 760 km.

551.510.536: 551.507.362.2 **193**

Radio Propagation Measurements using the Explorer VI Satellite.—C. D. Graves. (*J. geophys. Res.*, Sept. 1960, Vol. 65, No. 9, pp. 2585–2587.) Coherent signals at 108 and 378 Mc/s were emitted by the satellite. The results gave electron densities of about 10^4/cm^3 at 18 000 km above the earth. This is higher than expected and may have been influenced by an intense geomagnetic storm or by the need to make large corrections.

551.510.536: [551.594.6 + 551.507.362.2 **194**

The Electron Density Distribution derived from Whistler Data and Faraday-Fading Observations.—K. H. Schmelovsky. (*J. atmos. terr. Phys.*, Sept. 1960, Vol. 19, No. 1, pp. 68–71.) An interpolation law allows satellite observations to be combined with whistler data.

551.594.221 **195**

E.L.F. Electric Fields from Thunderstorms.—A. D. Watt. (*J. Res. nat. Bur. Stand.*, Sept./Oct. 1960, Vol. 64D, No. 5, pp. 425–433.) From an assumed cloud-to-ground discharge model calculations of wide-band vertical electric field variations indicate a small decrease with distance d up to 4 km, a d^{-1} relation to 20 km, and a d^{-2} relation beyond 30 km. Radiation-field spectrum analysis over the frequency range 1 c/s–300 kc/s indicates that below 300 c/s long discharges produce more energy than short discharges and that intercloud discharges may produce as much as cloud-to-ground discharges. Conclusions are supported by experimental evidence.

551.594.221 **196**

The Thunderstorms of 5 September 1958: Lightning Discharges and Atmospherics.—F. Horner. (*Met. Mag., Lond.*, Oct. 1960, Vol. 89, No. 1059, pp. 257–261.) Report on visual observations made at Slough, and an analysis of records taken by lightning-flash counters at Slough and other stations in the vicinity of the storm.

551.594.5 **197**

Direct Measurement of Particles producing Visible Auroras.—C. E. McIlwain. (*J. geophys. Res.*, Sept. 1960, Vol. 65, No. 9, pp. 2727–2747.) A large amount of auroral light is produced by electrons with energies < 10 keV.

551.594.5: 550.385.4 **198**

Large-Scale Auroral Motions and Polar Magnetic Disturbances: Part 1—A Polar Disturbance at about 1100 Hours on 23 September 1957.—S. I. Akasofu. (*J. atmos. terr. Phys.*, Sept. 1960, Vol. 19, No. 1, pp. 10–25.) A detailed study of a particular event suggests that both the westward auroral electrojet and the eastward auroral motion are produced simultaneously by a southward electric field, the origin of which is discussed. Over 50 references.

551.594.5: 621.396.96 **199**

The Height and Geometry of Auroral Radio Echoes.—C. D. Watkins. (*J. atmos. terr. Phys.*, Sept. 1960, Vol. 19, No. 1, pp. 1–9.) At Jodrell Bank, echoes at 4 m λ have been obtained only from regions where the line of sight is within 1° of perpendicularity to the local magnetic field lines at a height of about 110 km. See also 1429 of 1958 (Bullough et al.)

551.594.6 **200**

Analysis of Smooth-Type Atmospheric Waveforms.—F. Hepburn. (*J. atmos. terr. Phys.*, Sept. 1960, Vol. 19, No. 1, pp. 37–53.) Over 250 traces are analysed in an attempt to resolve previous conflicting results [e.g. 2888 of 1948 (Hales) and 2809 of 1952 (Caton & Pierce)]. The precise nature of observations necessary for the accurate analysis and reliable detection of deviations from simple theory is indicated.

551.594.6 **201**

Guiding of Whistlers in a Homogeneous Medium.—R. L. Smith. (*J. Res. nat. Bur. Stand.*, Sept./Oct. 1960, Vol. 64D, No. 5, pp. 505–508.) The velocity of energy flow of whistlers as a function of wave-normal angles is computed. Results differ from the longitudinal value except at very low frequencies or very small angles.

551.594.6: 539.16 **202**

Electromagnetic Signals from Nuclear Explosions in Outer Space.—M. H. Johnson & B. A. Lippmann. (*Phys. Rev.*, 1st Aug. 1960, Vol. 119, No. 3, pp. 827–828.) X-rays produced by a nuclear burst in outer space cause polarization currents in the medium, which, if distributed anisotropically, will emit e.m. radiation. A rough calculation indicates that a detectable 10-Mc/s signal is produced at a range of 1 km from a burst of X-ray energy equivalent to 1 ton of high explosive. The signal power varies as the square of the electron density, so this effect may provide a sensitive measure of the electron density in outer space.

551.594.6: 539.16 **203**

Bomb-Excited 'Whistlers'.—B. A. Lippmann. (*Proc. Inst. Radio Engrs*, Oct. 1960, Vol. 48, No. 10, pp. 1778–1779.) Reasons are given for the possible excitation of whistler modes by nuclear explosions, and characteristics of the signals to be expected are discussed.

551.594.6: 551.594.5 **204**

Audio-Frequency Electromagnetic Radiation in the Auroral Zone.—G. Gustafsson, A. Egeland & J. Aarons. (*J. geophys. Res.*, Sept. 1960, Vol. 65, No. 9, pp. 2749–2758.) Spectograms of the energy in the frequency range 10 c/s–10 kc/s were recorded in N. Sweden during the winter and early summer of 1958–1959. The energy is low during the day and high at night and the ratio is greatest in the

range 20–200 c/s. No clear-cut correlation with magnetic indices could be found except during some geomagnetic disturbances. The main contribution to the energy probably originates in atmospheric noise from thunderstorms but magnetic fluctuations may be important at lower frequencies.

LOCATION AND AIDS TO NAVIGATION

534.2-14: 534.88 **205**

A Systematic Error in Underwater Acoustic Direction-Finding.—J. J. Freeman. (*J. acoust. Soc. Amer.*, Aug. 1960, Vol. 32, No. 8, pp. 1025–1027.) The effect of the coherence between noise measured at different locations is examined and an evaluation is made of the systematic error introduced by this coherence in cross-correlator d.f. systems.

621.396.663: 621.396.677.6 **206**

Theory of the General Adcock.—Baxter. (See 42.)

621.396.931.2 **207**

Direction Finding at Low Frequencies.—L. E. Orsak & D. W. Martin. (*Electronics*, 16th Sept. 1960, Vol. 33, No. 38, pp. 74–77.) Details are given of a small rotating-loop direction finder for frequencies between 15 and 500 kc/s. Automatic operation is provided to give aural null indications or a c.r.o. display of the aerial pattern.

621.396.96 **208**

Polarization and Depression-Angle Dependence of Radar Terrain Return.—E. Kuhn & L. M. Spetner. (*J. Res. natl. Bur. Stand., Sect. Civ. Engng.*, 1960, Vol. 64D, No. 5, pp. 489–496.) Recent experimental data indicate that the polarization dependence of sea return cannot be explained by interference pattern analysis.

MATERIALS AND SUBSIDIARY TECHNIQUES

535.215 **209**

Photoconductivity of Complex Inorganic Compounds.—H. Schindler. (*Z. angew. Phys.*, Jan. 1960, Vol. 12, No. 1, pp. 33–38.) Measurements made on $K_3Fe(CN)_6$ and $K_2Mn(CN_5)NO$ are discussed.

535.215: 546.23 **210**

Some Electrical Properties of Amorphous Selenium Films.—R. A. Fotland. (*J. appl. Phys.*, Sept. 1960, Vol. 31, No. 9, pp. 1558–1565.) Results of measurements of dark-current and photocurrent characteristics, including hysteresis and transient effects, are given mainly in graphical form. 27 references.

535.215: 547.672 **211**

Charge-Carrier Production and Mobility in Anthracene Crystals.—R. G. Kepler. (*Phys. Rev.*, 15th Aug. 1960, Vol. 119, No. 4, pp. 1226–1229.) The drift mobilities of electrons and holes in anthracene crystals have been measured using a pulsed photoconductivity technique. The experimental results indicate that the charge carriers are produced at the surface of the crystal and not in the interior.

535.376 **212**

Measurement of Luminescence Decay Times of Inorganic Phosphors with Excitation by Ions.—A. Scharmann. (*Z. Phys.*, 16th Nov. 1959, Vol. 157, No. 3, pp. 301–315.) Measurements of decay times down to about 10^{-8}s on $MgWO_4$, $ZnWO_4$, $CdWO_4$, $CaWO_4$, CsI-Tl and NaCl-Ag show the decay to be exponential and independent of wavelength. The luminescence of ZnS-Cu decreases hyperbolically, and the blue emission band of ZnS-Mn shows similar behaviour.

535.376 **213**

The Luminescence Decay of ZnS-Cu, ZnS-S, ZnS-Zn, and ZnO-Zn with Excitation by 60-keV H_2^+ Ion Pulses.—K. H. Handel. (*Z. Phys.*, 16th Nov. 1959, Vol. 157, No. 3, pp. 316–323.) Increasing decay times were observed with the lengthening of ion-pulse duration. See also 212 above.

537.226: 536.421 **214**

Influence of Crystallographic Orientation on the Range Formation during Phase Changes in Solids.—S. Mascarenhas & E. G. Freitas. (*J. appl. Phys.*, Sept. 1960, Vol. 31, No. 9, pp. 1684–1685.) An experimental investigation of the thermoelectric effect which may be important in zone-refining techniques.

537.226: 621.378.2: 535.37 **215**

Some Effects allowed in Studying the Luminescence of ZnS Electrets.—V. M. Fridkin. (*Dokl. Akad. Nauk S.S.S.R.*, 11th March 1960, Vol. 131, No. 2, pp. 290–292.) The intensity of luminescence was greater when the applied field was opposite to the direction of the field during polarization. An effect similar to thermoluminescence was produced by heating.

537.227:.228 **216**

Dielectric Properties of Lead Titanate Zirconate Ceramics at Very Low Frequencies.—R. Gerson. (*J. appl. Phys.*, Sept. 1960, Vol. 31, No. 9, pp. 1615–1617.)

537.227 **217**

Crystal Structure of Ferroelectric $LiH_3(SeO_3)_2$.—K. Vedam, Y. Okaya & R. Pepinsky. (*Phys. Rev.*, 15th Aug. 1960, Vol. 119, No. 4, pp. 1252–1255.)

537.227: 546.431'824-31 **218**

Temperature Dependence of the Velocity of Sidewise 180° Domain-Wall Motion in $BaTiO_3$.—A. Savage & R. C. Miller. (*J. appl. Phys.*, Sept. 1960, Vol. 31, No. 9, pp. 1546–1549.) From 25° to 100 °C, the dependence is primarily due to the activation field and not the extrapolated velocity for $E = \infty$. The effect of impurities and crystal thickness is considered.

537.227: 546.431'824-31 **219**

The Electrical Conductivity of Barium Titanate Single Crystals.—A. Branwood & R. H. Tredgold. (*Proc. phys. Soc.*, 1st July 1960, Vol. 76, No. 487, pp. 93–98.) Conductivity was measured as a function of temperature, applied field, electrode material, thickness and time. Possible explanations of the striking non-ohmic nature of the conductivity are briefly discussed.

537.227: 546.431'824-31 **220**

The Influence of the Addition of Fe_2O_3, V_2O_5 and SnO_2 on Dielectric Properties of Barium Titanate Ceramics.—G. Lapluye, G. Morinet & P. Palla. (*C. R. Acad. Sci., Paris*, 4th Jan. 1960, Vol. 250, No. 1, pp. 79–81.)

537.227: 546.431'824-31 **221**

The Effect of the Incorporation of Metallic Oxides on the Properties of a Barium Titanate.—G. Lapluye, G. Morinet & P. Palla. (*C. R. Acad. Sci., Paris*, 11th Jan. 1960, Vol. 250, No. 2, pp. 305–307.)

537.228.1 **222**

Measurement of Coupling Coefficient and Q of Low-Q Piezoelectric Ceramics.—R. M. Glaister. (*Brit. J. appl. Phys.*, Aug. 1960, Vol. 11, No. 8, pp. 390–391.) Two methods are described, for deriving Q and the coupling coefficient for ceramics which do not exhibit antiresonance. An example is given.

537.311.33 **223**

The Role of Electron-Phonon Interaction in the Impurity Conduction of Semiconductors.—Y. Toyozawa. (*Prog. theor. Phys.*, Feb. 1960, Vol. 23, No. 2, pp. 273–290.) Factors contributing to impurity conduction in the low-concentration range are examined qualitatively.

537.311.33 **224**

Statistics of the Occupation of Dislocation Acceptors (One-Dimensional Interaction Statistics).—R. M. Broudy & J. W. McClure. (*J. appl. Phys.*, Sept. 1960, Vol. 31, No. 9, pp. 1511–1516.) Occupation statistics are derived taking account of interactions between nearest-neighbour electrons along a dislocation line in a semiconductor. Numerical results have been computed and are tabulated.

537.311.33 **225**

Bounds on the Nonlinear Diffusion-Controlled Growth Rate of Spherical Precipitates.—J. A. Morrison & H. L. Frisch. (*J. appl. Phys.*, Sept. 1960, Vol. 31, No. 9, pp. 1621–1627.)

537.311.33 **226**

Study of Charge Carriers in Semiconductors subjected to Strong Electric Fields.—J. Bok. (*Ann. Radioélect.*, April 1960, Vol. 15, No. 60, pp. 120–146. English abridgment, pp. 201–203.) A detailed experimental investigation of effects associated with 'hot' electrons. See also 3781 of 1959 (Bok & Veilex).

537.311.33 **227**

The Mechanism of Diffusion-Controlled Field Instabilities in Semi-

conductors at High Field Strengths.—H. Rother. (*Ann. Phys., Lpz.*, 15th Jan. 1960, Vol. 5, Nos. 3/4, pp. 203–210.) The conditions are derived for the growth of strong space-charge fields in semiconductors. A theoretical basis is established for the space-charge effects discussed by Böer & Rompe (249 below).

537.311.33: 534.2 **228**

Interaction of Conduction Electrons with Acoustic Waves in Simple Semiconductors.—N. Mikoshiba. (*J. phys. Soc. Japan*, June 1960, Vol. 15, No. 6, pp. 982–989.) A semi-classical theory is given. The extent to which various methods of approach are applicable is discussed and results are compared with those for monovalent metals.

537.311.33: 538.614 **229**

The Faraday Effect in Semiconductors due to Free Carriers in a Strong Magnetic Field.—L. É. Gurevich & I. P. Ipatova. (*Zh. eksp. teor. Fiz.*, Nov. 1959, Vol. 37, No. 5 (11), pp. 1324–1329.) The refractive indices calculated for various directions of the magnetic field relative to the main crystallographic axes depend strongly on the field direction. The components of the effective mass tensor can therefore be determined from measurement of the angle of rotation of the plane of polarization.

537.311.33: 538.615 **230**

Theory of Line Shapes of Interband Magneto-optical Absorption in Semiconductors.—T. Ohta, M. Nagae & T. Miyakawa. (*Progr. theor. Phys.*, Feb. 1960, Vol. 23, No. 2, pp. 229–250.) A fuller report of work described earlier by Ohta & Miyakawa (2422 of 1960).

537.311.33: [546.28 + 546.289 + 546.682'19 **231**

The Magnetic Susceptibility of Electrons in Silicon, Germanium and Indium Arsenide.—D. Geist. (*Z. Phys.*, 16th Nov. 1959, Vol. 157, No. 3, pp. 335–361.) Magnetic-balance methods of measuring susceptibility are discussed; the special balance used for measurements at 181° and 297°K, analysed in this paper will be described later. For preliminary results see 5510 of 1956 and 1050 of 1960.

537.311.33: [546.28 + 546.289] **232**

The Magnetic Susceptibility of Defect Electrons in Silicon and Germanium.—D. Geist. (*Z. Phys.*, 16th Dec. 1959, Vol. 157, No. 4, pp. 490–496.) See also 231 above.

537.311.33: [546.28 + 546.289] **233**

Auger Electron Ejection from Germanium and Silicon by Slow Ions.—H. D. Hagstrum. (*Phys. Rev.*, 15th Aug. 1960, Vol. 119, No. 4, pp. 940–942.)

537.311.33: 546.28 **234**

Diffusion Rate of Li in Si at Low Temperatures.—E. M. Pell. (*Phys. Rev.*, 15th Aug. 1960, Vol. 119, No. 4, pp. 1222–1225.) The method of ion drift in the electric field of an *np* junction has been used to measure the diffusion constant of Li in Si between 25 and 125°C.

537.311.33: 546.28 **235**

Effect of Li-B Ion Pairing on Li^+ Ion Drift in Si.—E. M. Pell. (*J. appl. Phys.*, Sept. 1960, Vol. 31, No. 9, pp. 1675–1679.)

537.311.33: 546.28 **236**

Diffusion of Li in Si at High *T* and the Isotope Effect.—E. M. Pell. (*Phys. Rev.*, 1st Aug. 1960, Vol. 119, No. 3, pp. 1014–1021.) Outdiffusion measurements with Li^8 and Li^9 at 800°C and 1 350°C are described, and the results discussed.

537.311.33: 546.28: 538.63 **237**

Low-Field Magnetoresistance Effect of Plastically Deformed *n*-Type Silicon.—K. Kamada. (*J. phys. Soc. Japan*, June 1960, Vol. 15, No. 6, pp. 990–1005.) Measurements show violation of the symmetry relation between the relaxation-time tensor and the effective-mass tensor. Theoretical consequences are discussed.

537.311.33: 546.28: 541.135 **238**

Capacitance Measurements at the Boundary Surface Silicon-Electrolyte.—K. Böke. (*Z. Naturf.*, May/June 1960, Vol. 15a, Nos. 5/6, pp. 550–551.) A discontinuity in the capacitance/reverse-voltage characteristic of thin Si specimens immersed in an electrolyte is used to prove the existence of a regular barrier layer formed in the specimen.

537.311.33: 546.289 **239**

Conductivity Emission of Germanium.—R. Seidl. (*Z. Phys.*, 8th Jan. 1960, Vol. 157, No. 5, pp. 560–575.) Report on experimental investigations in the temperature range 20°–260°C. Results indicate that traps located in the bulk of the material also give rise to the emission. See 3907 of 1960.

537.311.33: 546.289 **240**

Optical Observation of Auto-Ionic Interaction in Germanium.—J. Tauc & E. Antončík. (*Phys. Rev. Lett.*, 15th Sept. 1960, Vol. 5, No. 6, pp. 253–256.) A double peak in the reflection spectrum is explained by spin-orbit interaction.

537.311.33: 546.289: 535.215: 539.63 **241**

Spectral Distribution of the Photomagnetoelectric Effect in Ge Experiment.—J. A. Brand, A. D. Baker & H. Mette. (*Phys. Rev.*, 1st Aug. 1960, Vol. 119, No. 3, pp. 962–965.) A study of the effect in Ge as a function of wavelength from 0·7–2 μ, with particular reference to the conditions under which a sign reversal is obtained. Results are in good qualitative agreement with theoretical work of Garrett (240) of 1957).

537.311.33: 546.289: 535.311.33 **242**

Hall Mobility in Semiconductors with Two Conduction Bands: Germanium.—S. H. Koenig, G. A. Baraff & R. D. Brown. (*J. appl. Phys.*, Sept. 1960, Vol. 31, No. 9, p. 1699.) Measurements of the variation of Hall mobility with magnetic strength that are explained by the Gunn-Ehrenreich model together with scattering by point defects.

537.311.33: 546.289: 546.32'49 **243**

Impurity Conduction in Evaporated Single-Layer *p*-Type Germanium.—H. Fritzsche & M. Cuevas. (*Phys. Rev.*, 15th Aug. 1960, Vol. 119, No. 4, pp. 1238–1245.) The Hall coefficient and the resistivity of transmutation-doped Ge have been measured between 1·2 and 300°K. The impurity conduction was studied as a function of the separation between majority impurities and the results are compared with existing theories.

537.311.33: 546.289: 548.5 **244**

Germanium Crystals Grown from Hollow Cylindrical Seeds.—R. C. Frank & J. E. Thomas, Jr. (*J. appl. Phys.*, Sept. 1960, Vol. 31, No. 9, pp. 1689–1690.) Observations of the growth of single-crystal and polycrystalline tubular Ge seeds are reported.

537.311.33: 546.289'231 **245**

Electrical Properties of Germanium Selenide GeSe.—S. Asanabe & A. Okazaki. (*J. phys. Soc. Japan*, June 1960, Vol. 15, No. 6, pp. 989–997.) Experimental studies were made of electrical resistivity and Hall effect from 100° to 800°K. Results are interpreted qualitatively.

537.311.33: 546.47'221 **246**

The Interpretation of the *II* Values of ZnS Phases.—O. G. Folberth. (*Z. Naturf.*, May/June 1960, Vol. 15a, Nos. 5/6, pp. 432–434.) The variation in the width of the forbidden zone in semiconducting compounds of ZnS structure is discussed. See also 2084 of 1960.

537.311.33: 546.47'221 **247**

The Bonding in Crystals with 'Normal Valency' with Particular Reference to ZnS and Wurtzite Phases.—O. G. Folberth. (*Z. Naturf.*, May/June 1960, Vol. 15a, Nos. 5/6, pp. 425–431.) A modification of the earlier view, that the bonding in crystals of ZnS structure is mainly covalent, is justified.

537.311.33: 546.47.23 **248**

The Gunn-Ehrenreich Conduction Quenching Effect at Fine Grids.—K. Shiraishi. (*Z. Phys.*, 17th Dec. 1959, Vol. 157, No. 6, pp. 699–709.) Emission-emission and conductivity-glow curves were obtained for single-crystal and pure or doped powder material also X-ray luminescence. The maxima observed are attributed to centres in the surface layer. See also 1000 of 1961.

537.311.33: 546.48'22 **249**

Space-Charge Conditions in Semiconductors at High Field Strengths.—K. W. Böer & R. Rompe. (*Ann. Phys., Lpz.*, 15th Jan. 1960, Vol. 5, No. 1/2, pp. 66–80.) Results and considerations given already in 5 500 (high crystal of 1956 (Böer) are discussed and their validity with phonons in low-energy [2 $\times$ 10^{13} c/s] [...]

537.311.33: 546.48'221 **250**

Temperature-Gradient Controlled Growth of Large Single Crystals of CdS from Solution.—K. W. Böer & R. Claus. (*J. Amer. Soc.*, Jan. 1960, Vol. 43a, No. 1, pp. 9–16.) Crystals are obtained by vacuum deposition at 0·1 at 600°C, and are subjected heating up to 950°C to vapour for 5 min without the formation of a barrier layer being observed.

537.311.33: 546.561-31: 539.23 251

Change of Conductivity of Thin Cuprous Oxide Films with Electrostatic Charge.—A. Deubner & F. Schulz. (*Ann. Phys., Lpz.*, 15th Jan. 1960, Vol. 5, Nos. 3/4, pp. 113–128.) Conductivity and field effect were measured to determine the effect of the conditions under which the film was prepared. Field-effect measurements in vacuum were made in the temperature range −56° to +30°C. The results obtained at room temperature agree with those of Zückler (1452 of 1954); the behaviour observed at low temperatures cannot yet be interpreted.

537.311.33: 546.681'19 252

Thermal Conversion in n-Type GaAs.—J. J. Wysocki. (*J. appl. Phys.*, Sept. 1960, Vol. 31, No. 9, p. 1686.) Material with a carrier concentration of 5×10^{16}/cm³ or less changed to *p*-type when heated to 800°C for short times, due to Cu impurity in etching agents.

537.311.33: 546.681'19 253

Growth of GaAs Crystals in the <111> Polar Direction.—P. L. Moody, H. C. Gatos & M. C. Lavine. (*J. appl. Phys.*, Sept. 1960, Vol. 31, No. 9, pp. 1636–1637.)

537.311.33: 546.824.31-386.634-8 254

Ultrasonic Measurement of the Elastic Moduli of Barilo.—G. L. Vick & L. E. Hollander. (*J. acoust. Soc. Amer.*, Aug. 1960, Vol. 32, No. 8, pp. 967–969.)

537.311.33: 546.873'261: 537.323 255

The Thermal Conductivity and Thermoelectric Power of Bismuth Telluride at Low Temperatures.—F. L. Weiler. (*Phys. Rev.*, 1st July 1960, Vol. 30, No. 407, pp. 113–120.)

537.311.33: 621.387.463 256

Measurement of the Coefficient of Charge Collection in p-n Junction Particle Detectors. New Method of Measuring Lifetimes.—L. Rotti, J. Messier & G. Rossi. (*J. Electron. Control*, April 1960, Vol. 8, No. 4, pp. 288–300. In French.) An accurate value for the diffusion length of minority carrier may be obtained from the variation of the coefficient of charge collection as a function of surface penetration.

537.311.33 257

Changes in Superconducting Critical Temperature Produced by Electron-beam Irradiation.—R. S. Allgaier. (*Phys. Rev. Lett.*, 15th Sept. 1960, Vol. 5, No. 6, pp. 289–290.) Measurements of the superconducting transition temperature (*T*c) of tin and a tin/zinc solid solution (0·1% Zn) have been made before and after irradiation with 1·5 MeV electrons. Irradiation produces a decrease in *T*c which is proportional to the square of the fluence.

538.221 258

Ferromagnetic Cylinder Structures.—R. A. Beth & H. W. Dietz. (*Rev. mod. Phys.*, July 1960, Vol. 32, No. 3, pp. 649–656.) Theory is developed for a specially prepared material consisting of magnetic single domains for particles embedded in a non-magnetic matrix.

538.221 259

The Relaxation of Ferromagnetic Domain Walls.—R. Rothenstein. (*Z. Naturf.*, Feb. 1960, Vol. 15a, No. 2, pp. 169–171.) Internal friction effects are discussed with reference to Bloch-wall mobility measurements on iron wire at frequencies between 20 and 200 c/s [see also 3794 of 1959 (Rothenstein & Hrianca)].

538.221 260

Domain Tube Structures in Silicon Iron.—L. F. Bates & R. Carey. (*Proc. phys. Soc.*, 1st June 1960, Vol. 75, No. 486, pp. 880–884.) Results of a quantitative study of Néel spike formation are discussed in terms of a formula given by Brenner (485 of 1956) and an attempt is made to assess the importance of the phenomena in the explanation of coercivity.

538.221 261

Some Observations on the Domain Walls in Thin Films.—V. Gondii & Z. Funatogawa. (*J. phys. Soc. Japan*, June 1960, Vol. 15, No. 6, pp. 1126–1127.) Report of observations of colloidal patterns on 20% Fe-Ni films with uniaxial magnetic anisotropy.

538.221 262

Energy of Bloch Walls in Iron and Nickel.—L. Néel. (*Ann. Phys., Lpz.*, 15th Jan. 1960, Vol. 5, Nos. 3/4, pp. 117–126.) Calculations are made for 90° and 180° walls in Fe and for 70°, 110° and 180° walls in Ni.

538.221 263

Thermal and Electrical Properties of Cerium Iron at High Temperatures.—M. J. Lambeck. (*Canad. J. Phys.*, July 1960, Vol. 38, No. 7, pp. 867–887.)

538.221: 538.23 264

Theoretical Analytical Method and Graphical Procedure for the Determination of Magnetic Fields with Locally Variable Permeability.—H. G. Lindenau & A. H. Frey. (*Arch. Elektronik. Übertr.*, Dec. 1959, Vol. 13, No. 7, pp. 345–356.) Two methods for the determination of normal magnetic fields in ferromagnetic materials are described.

538.221: 546.431 265

On Influence of Ferromagnetism on Ferromagnetic Resonance in Metals.—M. Matsuo & M. Date. (*J. Phys. Soc. Japan*, June 1960, Vol. 15a, No. 10, pp. 1846–1851.) The influence of magnetic viscosity, porosity and of the non-magnetic field on the width of the ferromagnetic resonance curve is investigated for polycrystalline nickel.

538.221: 546.431 266

Ferromagnetic Resonance in Nickel Single Crystals.—R. M. Bozorth, H. J. Williams & D. E. Walsh. (*Phys. Rev.*, 1st July 1960, Vol. 103, No. 1, pp. 572–578.) Results of measurements on 99·98% pure Ni single crystals between 4·2°K and room temperature are compared with magnetization data.

538.221: 539.23 267

The Uniaxial Magnetic Anisotropy of Thin Films and its Change with Time.—Z. Málek, W. Schüppel, O. Stemme & W. Andrä. (*Ann. Phys., Lpz.*, 15th Jan. 1960, Vol. 5, Nos. 3/4, pp. 211–216.) Measurements were made on vapour-deposited Ni and permalloy films and on electrolytically deposited Ni film.

538.221: 539.23 268

Observations of the Magnetization Reversal Process in Thin Films of Nickel-Iron, using the Kerr Magneto-optic Effect.—M. Prutton. (*Brit. J. appl. Phys.*, Aug. 1960, Vol. 11, No. 8, pp. 333–338.) Experiments, using uniaxial films about 1500 Å thick, support that magnetization reversal may occur in three stages: (a) coherent rotation; (b) domain nucleation and growth; (c) further coherent rotation.

538.221: 539.23 269

Cross-Tie Walls in Thin Permalloy Films.—M. Prutton. (*Phil. Mag.*, June 1960, Vol. 5, No. 56, pp. 625–633.) A cross-tie wall is derived theoretically from a boundary-wall equation halfway between that of a Bloch and a Néel boundary. The energy density of the wall is estimated to be about 10 ergs/cm².

538.221: 546.74-31 270

Superconductive Ferromagnetism under Conditions of Stoichiometric Impurity in Nickel Oxide.—N. Perakis & G. Parravano. (*C. R. Acad. Sci., Paris*, 27th June 1960, Vol. 250, No. 1, pp. 677–678.) For a range of excess oxygen, ferromagnetic ordering is observed during cooling in a magnetic field, this disappearing on reheating to the Néel temperature.

538.221: 621.318.124 271

Original Magnetocrystalline Anisotropy in Hexagonal Oxides.—L. R. Bickford, Jr. (*Phys. Rev.*, 1st Aug. 1960, Vol. 120, No. 1, pp. 1090–1096.) Experimental results and theoretical discussion of torque measurements on single crystals of Co_2P and Co_2As between 77·3K and 600·9K.

538.221: 621.318.124 272

High-Permeability Garnets.—R. L. Barbour & J. B. Goodenough. (*J. appl. Phys., Supp.*, 1960, Vol. 31, No. 5, pp. 349S–350S.) Partial substitution of Ge for Al, or Ti for gallium results in a 1000% increase in initial permeability.

538.221: 621.318.124 273

Some Observations of Grain Structure in Polycrystalline Nickel Ferrite.—R. Gans & J. Hammond. Exploration of the Long Range and Polar Interactions of the Ferrite Unit Cell.—J. J. Went, E. W. Gorter, G. W. van Oosterhout, A. L. Stuijts & J. Smit. (*Rep. Progr. Phys.*, 1956, Vol. 19, pp. 305–353.) A comprehensive review of the present state of knowledge of the ferrites.

538.221: 621.318.124: 538.245.6 274

On Weak Effects in Ferromagnetic Resonance Experiments.—W. H. Yeadon & D. J. Standley. (*Proc. phys. Soc.*, 1st July

1960, Vol. 76, No. 487, pp. 99–103, plate.) The magnitude and sign of the wall shift was determined at wavelengths in the range of 0·87 to 3·12 cm and at temperatures between 20 and 300°C, using small spheres of Ni ferrite, Mg-Mn ferrite and Y-Fe garnet. A proposed simple model agrees with results in sign and order of magnitude.

538.221: 621.318.134: 538.569.4 **275**

Walker Modes in Large Ferrite Samples.—B. A. Auld. (*J. appl. Phys.*, Sept. 1960, Vol. 31, No. 9, pp. 1642–1647.) "The modes of resonance for a ferrite strip and a ferrite post resonator between conducting planes are found by taking appropriate combinations of uniform plane-wave solutions. It is shown that magnetostatic resonances (Walker modes) may exist even when the resonator dimensions are arbitrarily large, provided the mode indices satisfy certain restrictions."

538.221: 621.318.134: 538.569.4 **276**

Magnetostatic Modes in Disks and Rods.—J. F. Dillon, Jr. (*J. appl. Phys.*, Sept. 1960, Vol. 31, No. 9, pp. 1605–1614.) Ferrimagnetic-resonance experiments on samples of single crystals of Mn ferrite and Y-Fe garnet show many magnetostatic modes as absorption maxima. Varying r.f. field configurations aid the identification of modes. The narrowest lines were observed when the steady field was normal to the plane of a thin disk.

538.221: 621.318.134: 538.569.4 **277**

Investigation of the Variation of the Magnetic Moment of an Yttrium Garnet Single Crystal in a Ferromagnetic-Resonance Experiment at 9350 Mc/s.—J. Hervé & M. Sauzade. (*C. R. Acad. Sci., Paris*, 4th Jan. 1960, Vol. 250, No. 1, pp. 82–84.)

538.221: 621.318.134: 538.632 **278**

Hall Effect in Ferrites near the Curie Temperature.—K. P. Belov & E. P. Svirina. (*Zh. eksp. teor. Fiz.*, Nov. 1959, Vol. 37, No. 5 (11), pp. 1212–1216.) Report of measurements of Hall e.m.f. in single-crystal and polycrystalline specimens of Ni-Zn and Mn ferrites.

538.222 **279**

Spin-Phonon Interaction in Paramagnetic Crystals.—R. D. Mattuck & M. W. P. Strandberg. (*Phys. Rev.*, 15th Aug. 1960, Vol. 119, No. 4, pp. 1204–1217.)

538.222: 538.569.4 **280**

Electron Spin-Lattice Relaxation in Dilute Potassium Chromicyanide at Helium Temperatures.—J. G. Castle, Jr, P. F. Chester & P. E. Wagner. (*Phys. Rev.*, 1st Aug. 1960, Vol. 119, No. 3, pp. 953–961.)

538.222: 538.569.4 **281**

Paramagnetic Resonance of V^{4+} in TiO_2.—H. J. Gerritsen & H. R. Lewis. (*Phys. Rev.*, 1st Aug. 1960, Vol. 119, No. 3, pp. 1010–1012.) Observations at 10·14 and 22·68 Gc/s indicate that the spectrum is due to single *d* electrons of tetravalent V ions located at titania sites in the lattice.

538.222: 538.569.4 **282**

Cross-Relaxation in Ruby.—W. B. Mims & J. D. McGee. (*Phys. Rev.*, 15th Aug. 1960, Vol. 119, No. 4, pp. 1233–1237.) A pulsed microwave method has been used to study relaxation in synthetic ruby. Cross-relaxation effects appear in the form of decay traces having two or more periods.

538.222: 538.569.4: 621.375.9 **283**

Chromium-Doped Titania as a Maser Material.—H. J. Gerritsen, S. E. Harrison & H. R. Lewis. (*J. appl. Phys.*, Sept. 1960, Vol. 31, No. 9, pp. 1566–1571.) Describes the properties of a new maser material, which can be used to extend the frequency range of masers and should lead to improved amplifiers at the lower frequencies. Energy level diagrams are included for magnetic fields in the (110), ($1\bar{1}0$), (001) and (100) planes.

621.315.55: 621.3.032.27 **284**

Hard Gallium Alloys for Use as Low-Contact-Resistance Electrodes and for Bonding Thermocouples into Samples.—G. G. Harman. (*Rev. sci. Instrum.*, July 1960, Vol. 31, No. 7, pp. 717–720.) Ga alloys are described which can be prepared in a similar way to dental amalgams and packed into cavities in semiconductors to bond wires. Operating temperature range extends to 900°C.

MATHEMATICS

512.3 **285**

Minimal Positive Polynomials.—J. E. Eaton. (*Trans. Inst. Radio Engrs*, March 1960, Vol. MTT-8, No. 2, p. 171. Abstract, *Proc. Inst. Radio Engrs*, June 1960, Vol. 48, No. 6, Part 1, p. 1195.)

517.512.71 **286**

Canonical and Hamiltonian Formalism applied to the Sturm-Liouville Equation.—M. A. Biot & I. Tolstoy. (*Quart. appl. Math.*, July 1960, Vol. 18, No. 2, pp. 163–172.) The Sturm-Liouville equation is expressed in Hamiltonian form. The method is developed with particular reference to the wave equation; it unifies many apparently diverse treatments, and leads to new procedures.

517.923.4 **287**

Note on the Solution of Riccati's Differential Equation.—H. H. Howe. (*J. Res. nat. Bur. Stand.*, April–June 1960, Vol. 64B, No. 2, pp. 95–98.) Solutions given in terms of recurrence formulae are suitable for use in radio propagation problems.

517.942.9: 517.949 **288**

The Stability of Computation of the Pierce-Cauchy Problem.—B. Meltzer. (*J. Electronics Control*, June 1960, Vol. 8, No. 6, pp. 449–453.) "Limits are found analytically for rate of growth of error in computation—by 'marching' methods—of solutions of the finite-difference form of Laplace's equation in two dimensions, with Cauchy boundary conditions. A series of alternative nonmarching methods are proposed, which should be stable."

519 **289**

The Kron Method of Tearing and the Dual Method of Identification.—A. I. Weinzweig. (*Quart. appl. Math.*, July 1960, Vol. 18, No. 2, pp. 183–190.) A precise mathematical formulation of the Kron method for solution of network problems (3582 of 1957) is presented. This establishes the validity of the method, and simplifies and extends it.

MEASUREMENTS AND TEST GEAR

529.786: 525.35: 523.745 **290**

Effect of the Solar Activity on the Earth's Rotation.—Uyeda, Saburi & Iwasaki. (See 159.)

621.3.018.41(083.74): 621.372.412.002 **291**

Adjusting Methods of the Frequency and its Temperature Coefficient of 100 kc/s GT-Cut Crystals used for the Primary Frequency Standards.—Y. Hiruta. (*J. Radio Res. Labs, Japan*, May 1960, Vol. 7, No. 31, pp. 263–276.) See also 62 above.

621.317.088.6: 519.281.3 **292**

The Practice of Linear and Parabolic Correction of Measured Values.—G. Ohl. (*Arch. elekt. Übertragung*, Dec. 1959, Vol. 13, No. 12, pp. 530–532.) Explicit correction formulae are given based on the method of least squares.

621.317.3/.4: 538.632 **293**

The Hall Generator and its Application to Measurement Techniques.—F. Kuhrt. (*Elektronische Rundschau*, Jan. 1960, Vol. 14, No. 1, pp. 10–13.) The characteristics of Hall generators are summarized and some Hall-effect devices and their applications are briefly reviewed. 21 references.

621.317.332.1: 621.372.2 **294**

Investigation of Balanced High-Frequency Transmission Lines.—Lauterjung. (See 19.)

621.317.335.3: 621.372.8 **295**

A Graphical Method for Measuring Dielectric Constants at Microwave Frequencies.—C. B. Sharpe. (*Trans. Inst. Radio Engrs*, March 1960, Vol. MTT-8, No. 2, pp. 155–159. Abstract, *Proc. Inst. Radio Engrs*, June 1960, Vol. 48, No. 6, Part 1, p. 1195.)

621.317.34: 621.372.852.12 **296**

Half-Round Inductive Obstacles in Rectangular Waveguide.—Kerns. (See 31.)

621.317.373: 621.396.663 **297**

Goniometer Measuring Systems for High Frequencies: Part 2—Phase Angle

Measurement.—H. Fricke. (*Arch. tech. Messen*, Nov. 1959, No. 286, pp. 225–226.) Part 1: 3613 of 1960.

621.317.373.029.6: 621.372.632 **298**

Measurement of Relative Phase Shift at Microwave Frequencies.—C. A. Finnila, L. A. Roberts & C. Süsskind. (*Trans. Inst. Radio Engrs*, March 1960, Vol. MTT-8, No. 2, pp. 143–147. Abstract, *Proc. Inst. Radio Engrs*, June 1960, Vol. 48, No. 6, Part 1, pp. 1194–1195.)

621.317.39: 534.232 **299**

A Capacitive Probe for the Measurement of Very Small Deflections in the Frequency Range 50 c/s–2·0 Mc/s.—H. Herold & A. Lenk. (*Hochfrequenztech. u. Elektroakust.*, Dec. 1959, Vol. 68, No. 5, pp. 152–158.) The design is described of equipment for measuring the amplitude of vibrations, in the range 0·1–1 mμ, of piezoelectric resonators.

621.317.39.029.6: 537.525 **300**

Microwave Method of Investigating the Afterglows of Pulsed Gaseous Discharges.—M. C. Sexton, J. J. Lennon & M. J. Mulcahy. (*Brit. J. appl. Phys.*, Aug. 1959, Vol. 10, No. 8, pp. 356–359.) Apparatus suitable for recording the decrease of electron density in the afterglows of pulsed microwave discharges at 3 and 10 cm λ is described, which measures the frequency shift induced in a resonant cavity by free electrons. An improved method allows the modulation envelope to be removed by means of a hybrid T-junction, so that only the cavity reflection is fed to the display apparatus.

621.317.42: 538.569.4 **301**

Radio Measurement of a Value of Magnetic Induction and of its Stability in Time.—C. Fric & H. Hahn. (*C. R. Acad. Sci., Paris*, 25th Jan. 1960, Vol. 250, No. 1, pp. 680–682.) A method is described for measuring directly the magnetic induction in the air gap of an electromagnet by an instantaneous reading of the frequency of a maser-type self-oscillator [798 of 1960 (Fric)].

621.317.42: 538.632 **302**

Hall-Effect Devices of Small Dimensions.—V. Andresciani. (*Note Recensioni Notiz.*, Jan./Feb. 1960, Vol. 9, No. 1, pp. 61–72.) The method of construction of devices used for magnetic-field and microwave power measurements is described.

621.317.44: 539.23 **303**

Sensitive Flux Measurement of Thin Magnetic Films.—H. J. Oguey. (*Rev. sci. Instrum.*, July 1960, Vol. 31, No. 7, pp. 701–709.) The difficulties of flux calibration and noise reduction are examined.

621.317.61 **304**

Measurement of Complex Voltage Ratio.—E. R. Wigan. (*Electronic Technol.*, Nov. 1960, Vol. 37, No. 11, pp. 422–428.) Description of a technique for the precise measurement of the vector ratio between two alternating voltages by allowing the apparatus to measure its own errors. The technique is applied to measurements using a 'Cartesian-coordinate' a.c. potentiometer.

621.317.733.011.3 **305**

Improved Square-Wave Inductance Bridge.—B. Howland. (*Rev. sci. Instrum., July 1960*, Vol. 31, No. 7, pp. 763–768.) The bridge described is used to determine the elements of an inductor with one square-wave null measurement in the range 0·1–350 kc/s. A design for use at v.h.f. is also given. Screening problems are simplified by using a wideband transformer with a coaxial secondary winding.

621.317.79.029.6: 621.372.012 **306**

Analysis of Microwave Measurement Techniques by means of Signal Flow Graphs.—J. K. Hunton. (*Trans. Inst. Radio Engrs*, March 1960, Vol. MTT-8, No. 2, pp. 206–212. Abstract, *Proc. Inst. Radio Engrs*, June 1960, Vol. 48, No. 6, Part 1, p. 1195.)

621.317.79.029.65 **307**

High-Resolution Millimetre-Wave Fabry-Perot Interferometer.—W. Culshaw. (*Trans. Inst. Radio Engrs*, March 1960, Vol. MTT-8, No. 2, pp. 182–189. Abstract, *Proc. Inst. Radio Engrs*, June 1960, Vol. 48, No. 6, Part 1, p. 1195.)

OTHER APPLICATIONS OF RADIO AND ELECTRONICS

621.317.39: 612 **308**

The Problem of the Electronic Measurement and Recording of Physiological Phenomena in Test Subjects under Physical Stress.—W. Nicolai. (*Elektronik*, Jan. 1960, Vol. 9, No. 1, pp. 5–11. Correction, Feb. 1960, Vol. 9, No. 2, p. 64.) Equipment for recording and transmitting data on muscle and heart activity of athletes is described, and recordings obtained are discussed.

621.383.8: 527 **309**

Star Tracker uses Electronic Scanning.—W. D. Atwill. (*Electronics*, 20th Sept. 1960, Vol. 33, No. 40, pp. 88–91.) A star image on a phototube is scanned electronically and the error signal, which is generated when the optical axis of the tracker deviates from the line of sight to the star, is used to correct the telescope alignment.

621.384.61 **310**

Natural Functions of Betatron Oscillations in a Circular Phasotron.—Zh. Loshak. (*Zh. tekh. Fiz.*, Aug. 1959, Vol. 29, No. 8, pp. 995–1008.) Analysis of the natural oscillations in a simplified model of an accelerator with an alternating radial field. The application of the expressions derived for studying 'resonance tones' and the effects of distortion of the magnetic field are considered.

621.385.833 **311**

Coherent Splitting of an Electron Beam by Magnetic Fields.—E. Krimmel. (*Z. Phys.*, 25th Jan. 1960, Vol. 158, No. 1, pp. 35–38.) Description of a magnetostatic biprism for electron-interferometry applications.

621.385.833 **312**

Defocusing Contrast in Coherent Illumination: Case of a Periodic Object in Electron Microscopy.—M. Fagot & C. Fert. (*C. R. Acad. Sci., Paris*, 4th Jan. 1960, Vol. 250, No. 1, pp. 94–96.)

621.385.833 **313**

Shot and Scintillation Noise in Cold Electron Emission.—C. Kleint & H. J. Gasse. (*Z. Naturf.*, Jan. 1960, Vol. 15a, No. 1, pp. 87–88.) Preliminary note on noise measurements in field-emission microscopes.

621.387.462 **314**

The Individual Counting of β Particles by means of Germanium and Silicon Junction Diodes.—H. D. Engler. (*Z. Naturf.*, Jan. 1960, Vol. 15a, No. 1, pp. 82–84.) β-spectra obtained with the diodes described are given.

621.387.462 **315**

Large-Area Germanium Surface-Barrier Counters.—F. J. Walter, J. W. T. Dabbs & L. D. Roberts. (*Rev. sci. Instrum.*, July 1960, Vol. 31, No. 7, pp. 756–762.) A solid-state counter of good resolution and stability with a fast rise time suitable for counting heavy charged particles is described.

PROPAGATION OF WAVES

621.391.812.3.029.63: 523.3 **316**

Computation and Measurement of the Fading Rate of Moon-Reflected U.H.F. Signals.—S. J. Fricker, R. P. Ingalls, W. C. Mason, M. L. Stone & D. W. Swift. (*J. Res. nat. Bur. Stand.*, Sept./Oct. 1960, Vol. 64D, No. 5, pp. 455–465.) Calculations of the total libration rate lead to an evaluation of the Doppler spread from which fading rates can be deduced. Good agreement with observational data at a frequency of 412 Mc/s is obtained.

621.391.812.6.029.62/.64 **317**

Observational Results of V.H.F., U.H.F. and S.H.F. Propagation Beyond the Radio Horizon.—A. Takahira, H. Irie & T. Nakamura. (*J. Radio Res. Labs, Japan*, May 1960, Vol. 7, No. 31, pp. 197–211.) Propagation experiments have been conducted at 150 and 600 Mc/s and 3 and 10 Gc/s over a 125-km land path. During the day, (*a*) in the v.h.f. band, reflected and diffracted waves are superposed, (*b*) in the u.h.f. band, reflected waves predominate, and (*c*) at 3 and 10 Gc/s scattered waves predominate. At night-time reflected waves are predominant in all bands.

621.391.812.62.029.62/.63 **318**

Studies in the U.H.F. Overland Propagation Beyond the Horizon.—M. Hirai, K. Nishikori, M. Fukushima, Y.

Kurihara, R. Inoue, M. Ikeda, S. Niwa & Y. Kido. (*J. Radio Res. Labs, Japan*, May 1960, Vol. 7, No. 31, pp. 137–176.) Report of a series of experiments conducted over paths of 226 and 345 km on frequencies of 160, 600 and 2 120 Mc/s. See also 244 of 1959 (Onoe et al.).

621.391.812.621 **319**

Methods of Predicting the Atmospheric Bending of Radio Rays.—B. R. Bean, G. D. Thayer & B. A. Cahoon. (*J. Res. nat. Bur. Stand.*, Sept./Oct. 1960, Vol. 64D, No. 5, pp. 487–492.) Results derived from radiosonde measurements are incorporated in a comparison analysis to assess the relative accuracy of three methods for the prediction of bending when the refractive-index profile is unknown.

621.391.812.63.029.62 **320**

Experiments of Long Distance Ionospheric Propagation on V.H.F.—K. Tao, K. Sawaji, A. Sakurazawa & M. Yamaoka. (*J. Radio Res. Labs, Japan*, May 1960, Vol. 7, No. 31, pp. 177–196.) Results are given of tests at 50 Mc/s over distances from 1 000 to 3 380 km during a summer-period of one month. The received signals have been statistically analysed and classified as propagated by sporadic-E, ionospheric scattering and a combination of both types of propagation.

621.391.812.63.029.63: 551.510.535 **321**

Some Characteristics of Ionospheric Back-Scatter Observed at 440 Mc/s.—Pines, Kraft & Briscoe. (See 188.)

RECEPTION

621.391.82 **322**

Detection of a Signal Specified Exactly with a Noisy Stored Reference Signal.—T. G. Birdsall. (*J. acoust. Soc. Amer.*, Aug. 1960, Vol. 32, No. 8, pp. 1038–1045.) The performances of both the optimum receiver for detecting the presence of a signal in white Gaussian noise and the cross-correlation receiver with storage noise are calculated and compared for a special case.

STATIONS AND COMMUNICATION SYSTEMS

621.391 **323**

Some Further Theory of Group Codes.—D. Slepian. (*Bell. Syst. tech. J.*, Sept. 1960, Vol. 39, No. 5, pp. 1219–1252.)

621.394.441 **324**

A Voice-Frequency Telegraphy System with Narrow-Band Frequency Modulation and Transistors.—H. Heller. (*Nachrichtentech. Z.*, Dec. 1959, Vol. 12, No. 12, pp. 595–601.)

621.396: 621.391.812.63 **325**

A Proposed Technique for F-Layer Scatter Propagation.—W. C. Vergara & J. L. Levatich. (*Proc. Inst. Radio Engrs*, Oct. 1960, Vol. 48, No. 10, p. 1790.) The technique proposed is to use frequencies above the classical F_2-layer M.U.F. which are calculated assuming a Gaussian distribution of 'elemental' M.U.F.'s associated with irregularly ionized volumes in the ionosphere.

621.396.4: 523.5 **326**

Loss in the Channel Capacity Resulting from Starting Delay in Meteor-Burst Communication.—G. R. Sugar. (*J. Res. nat. Bur. Stand.*, Sept./Oct. 1960, Vol. 64D, No. 5, pp. 493–494.) For idealized specular underdense trails theory confirms the experimentally observed exponential signal burst-width/amplitude distribution for durations up to 0·5 sec and predicts a channel capacity loss which increases with frequency below 100 Mc/s.

621.396.4: 523.5 **327**

Elementary Considerations of the Effects of Multipath Propagation in Meteor-Burst Communication.—G. R. Sugar, R. J. Carpenter & G. R. Ochs. (*J. Res. nat. Bur. Stand.*, Sept./Oct. 1960, Vol. 64D, No. 5, pp. 495–500.) An examination is made of the effects of (*a*) the simultaneous existence of two meteor trails, (*b*) the existence of a Rayleigh-fading background continuum, and (*c*) the existence of two first Fresnel zones along a single meteor trail.

621.396.43: 629.19 **328**

Scattering by a Spherical Satellite.—E. M. Kennaugh, S. P. Morgan & H. Weil. (*Proc. Inst. Radio Engrs*, Oct. 1960, Vol. 48, No. 10, p. 1781.) Critical comment on 2515 of 1960 (Vea et al.).

621.396.43: 629.19 **329**

Scattering Properties of Large Spheres.—N. A. Logan. (*Proc. Inst. Radio Engrs*, Oct. 1960, Vol. 48, No. 10, p. 1782.) Critical comment on 2515 of 1960 (Vea et al.).

621.396.65 **330**

7-Gc/s Miniature Radio Link.—R. Schienemann. (*Telefunken Ztg*, Dec. 1959, Vol. 32, No. 126, pp. 251–264. English summary, pp. 292–293.) Details are given of the design and performance of radio-link equipment which provides six speech or teletype channels and one service channel. The range is 50 km but can be extended to 300 km by means of relay stations.

621.396.74.029.62/.63 **331**

***List* of V.H.F. Transmitters in the German Federal Republic and the Soviet-Occupied Zone.**—(*Rundfunktech. Mitt.*, Dec. 1959, Vol. 3, No. 6, pp. 293–296.) The lists and map of transmitter locations give the position as at 1st November 1959. For similar data on short-wave and long- and medium-wave transmitters see *ibid.*, pp. 297–301.

621.396.931 **332**

Communication System for Highway Traffic Control.—E. A. Hanyaz, J. E. Stevens & A. Meduvsky. (*Electronics*, 14th Oct. 1960, Vol. 33, No. 42, pp. 81–83.) A v.l.f. loop system at the roadside transmits messages to passing cars. A tape recorder transmits continuous fixed messages using a pick-up system which exerts no frictional force on the tape.

621.396.97: 534.76 **333**

Stereophonic Transmission of Broadcasts using F.M. Signals and an A.M. Subcarrier.—F. L. H. M. Stumpers & R. Schutte. (*Elektronische Rundschau*, Dec. 1959, Vol. 13, No. 12, pp. 445–446.) A compatible method is described which involves little expenditure on the receiver side and requires only a narrow bandwidth.

621.396.97: 534.76 **334**

The P.A.M. Method of Stereophonic Broadcasting.—G. Janus. (*Elektronische Rundschau*, Dec. 1959, Vol. 13, No. 12, pp. 447–449.) A single-channel, compatible method is described.

SUBSIDIARY APPARATUS

621-526: 681.142 **335**

Analysing Magnetically Detented Stepper Servo Motors.—H. J. Weber & M. Weiss. (*Electronics*, 23rd Sept. 1960, Vol. 33, No. 39, pp. 71–74.) Digital test equipment for evaluating the performance of a motor used for digital/analogue conversion is described.

621.3.087.4: 621.395.625.3 **336**

Recording Accuracy in Magnetic Tape Recording.—H. Völz. (*Elektronische Rundschau*, Jan. 1960, Vol. 14, No. 1, pp. 23–25.) The accuracy is defined on the basis of information theory, and the capacity of a magnetic-tape communication channel is calculated taking account of signal/noise ratio and undesirable a.m. and f.m. effects.

621.311.69: 621.383.2 **337**

Photovoltaic Effect Produced in Silicon Solar Cells by X and Gamma Rays.—K. Scharf. (*J. Res. nat. Bur. Stand.*, July/Aug. 1960, Vol. 64A, No. 4, pp. 297–307.)

621.316.722 **338**

On the Realization of a Highly Stable Direct-Current Power Supply with a Wide Range of Output Voltage.—G. Girault & J. Lagasse. (*C. R. Acad. Sci., Paris*, 4th Jan. 1960, Vol. 250, No. 1, pp. 91–93.) The principle of operation of a stabilized power supply incorporating two feedback loops is described. The properties of the circuit are deduced from transfer functions.

621.316.722.078: 621.382.3 **339**

Designing Transistorized Voltage Regulators.—E. Wilson. (*Electronics*, 23rd Sept. 1960, Vol. 33, No. 39, pp. 62–65.) A detailed analysis of the design of a d.c. series regulator with temperature compensation.

TELEVISION AND PHOTOTELEGRAPHY

621.397.132 340

Colour Television Standards.—R. D. A. Maurice. (*Wireless World*, Nov. 1960, Vol. 66, No. 11, pp. 536–537.) The ½-line-frequency offset commonly used for the N.T.S.C.-type colour subcarrier is considered inferior to ½-line-frequency 'precision best offset' from the point of view of co-channel interference. It is proposed that the colour subcarrier frequency for the 625-line system should be changed from 4·429 687 5 Mc/s to 4·430 800 Mc/s and that the number of lines per picture be changed from 625 to 627.

621.397.132 : 535.62 341

Does Dr. Edwin H. Land's Theory of Colour Vision Form the Basis for a New Colour Television System?—P. Neidhardt. (*Elektronische Rundschau*, Dec. 1959, Vol. 13, No. 12, pp. 451–457.) The two-component theory of colour vision [see e.g. 2677 of 1960 (Woolfson)] cannot provide a satisfactory basis for a colour television system.

621.397.132 : 621.372.55 342

The Vestigial-Sideband Equalization of the Chrominance Signal in the N.T.S.C. System.—H. Schönfelder. (*Arch. elekt. Übertragung*, Jan. 1960, Vol. 14, No. 1, pp. 37–46.) Crosstalk and frequency-response distortion due to vestigial-sideband transmission of the *I*-component can be eliminated by means of equalizer circuits in the colour-television receiver. Such circuits are described and their effect on picture quality is considered.

621.397.132 : 621.397.62 343

Generator of Synchronizing Signals for the Colour Subcarrier.—L. Accardi. (*Note Recensioni Notiz.*, Nov.–Dec. 1959, Vol. 8, No. 6, pp. 653–662.) A circuit is described which is capable of producing bursts of oscillation conforming to the waveform requirements of the N.T.S.C. system.

621.397.132 : 621.397.62 344

Demodulation of Chrominance Signals in Colour Television Receivers.—C. Massari. (*Note Recensioni Notiz.*, Jan.–Feb. 1960, Vol. 9, No. 1, pp. 73–112.) The design of decoding circuits for the N.T.S.C. system is reviewed.

621.397.132.001.4 345

Colour Bar Generator for the N.T.S.C. Standard.—G. Bolle. (*Telefunken Ztg*, Dec. 1959, Vol. 32, No. 126, pp. 237–243. English summary, pp. 290–292.) In the equipment described closely coordinated luminance and chrominance signals are produced, and the sequence of colours can be changed at will.

621.397.332 346

Synchronizing System for Two Sinusoidal Voltages of Nearly Equal Frequency Applied to the Scanning of Camera Tubes.—C. Curie & B. Cazeneuve. (*C. R. Acad. Sci., Paris*, 18th Jan. 1960, Vol. 250, No. 3, pp. 491–493.) A scanning system is proposed based on the properties of Lissajous figures. Two sinusoidal signals at frequencies of 16·17 and 16·20 kc/s derived by frequency division from a single quartz oscillator are used to obtain a scanning rate of 30 pictures/sec. Details are given of the oscillator and frequency-division circuits. The 'definition' obtained on a closed-circuit system was comparable to that of a normal television image.

621.397.61 347

A Vertical-Aperture Equalizer for Television.—W. G. Gibson & A. C. Schroeder. (*J. Soc. Mot. Pict. Telev. Engrs*, June 1960, Vol. 69, No. 6, pp. 395–401.) General description of a vertical-aperture equalizer which, by delaying the video signal by one scanning line increases the subjective sharpness of the television picture. See also 1685 of 1956 (Schroeder & Gibson).

621.397.61 348

The Minimum Distances between Interfering Television Transmitters.—H. Eden & K. H. Kaltbeitzer. (*Rundfunktech. Mitt.*, Dec. 1959, Vol. 3, No. 6, pp. 271–276.) A method of calculating the minimum geographical separation between transmitters is given. For English version see *E.B.U. Rev.*, Dec. 1959, No. 58A, pp. 14–18.

621.397.62 349

Automatic Matching of Contrast and Background Brightness in Television Receivers to Room Lighting.—R. Suhrmann. (*Elektronische Rundschau*, Dec. 1959, Vol. 13, No. 12, pp. 441–444. Correction, Jan. 1960, Vol. 14, No. 1, p. 33.) Photocell circuits for automatic contrast control are given and methods are discussed for raising screen brightness in proportion to ambient lighting, with or without a threshold level for the control action.

621.397.62.001.4 350

Equipment for the Subjective Testing of Television Receivers.—H. F. Leigemann. (*Telefunken Ztg*, Dec. 1959, Vol. 32, No. 126, pp. 244–250. English summary, p. 292.) The equipment described enables the images produced by two receivers to be displayed in adjacent sections on the same screen; this is done by means of an electronic switch, and facilitates image comparison.

621.397.621 351

Flywheel-Synchronized Horizontal-Deflection Systems in Television Receivers under Conditions of Fluctuating Line Frequency.—H. Grosskopf & H. Springer. (*Radio Mentor*, April 1960, Vol. 26, No. 4, pp. 269–271.) The problem of minimizing jitter on indirectly synchronized receivers is discussed. Establishment of tolerance limits for the sensitivity of receivers to line-frequency fluctuations would be desirable.

621.397.7 352

Television Switching Centre Frankfurt Main.—K. Thom. (*Rundfunktech. Mitt.*, Dec. 1959, Vol. 3, No. 6, pp. 257–259.) Planning and design of a regional video-signal switching centre are discussed; a sound-signal switching centre for the same network has been in operation for some time.

621.397.7 353

Portable Television Outside-Broadcast Equipment.—E. Legler. (*Rundfunktech. Mitt.*, Dec. 1959, Vol. 3, No. 6, pp. 253–256.) The equipment described comprises a vidicon camera, pulse generator and band-IV transmitter with aerial; it weighs 11·4 kg and can be carried by one person.

621.397.7-182.3 354

The Equipment of a New Television Outside-Broadcast Vehicle for the N.W.R.V. Hamburg.—G. Schadwinkel. (*Rundfunktech. Mitt.*, Dec. 1959, Vol. 3, No. 6, pp. 263–265.) Details additional to those contained in 1037 of March (Schadwinkel & Käding) are given.

621.397.7(43) 355

The Television Network of the German Federal Republic and the Soviet-Occupied Zone.—(*Rundfunktech. Mitt.*, Dec. 1959, Vol. 3, No. 6, pp. 285–292.) Tabulated data on television transmitters as at 1st November 1959 with maps showing their location and that of television links.

VALVES AND THERMIONICS

621.382 356

The Oscillistor—New Type of Semiconductor Oscillator.—R. D. Larrabee & M. C. Steele. (*J. appl. Phys.*, Sept. 1960, Vol. 31, No. 9, pp. 1519–1523.) A new magneto-oscillatory effect has been observed in the electron-hole plasma within a semiconductor. When the specimen is subjected to an electric field and a magnetic field, current oscillations can be detected across a series load resistance.

621.382 (083.74) 357

I.R.E. Standards on Solid-State Devices: Definitions of Semiconductor Terms, 1960.—(*Proc. Inst. Radio Engrs*, Oct. 1960, Vol. 48, No. 10, pp. 1772–1775.) Standard 60 I.R.E. 28.S1.

621.382.23 358

Temperature Dependence of Tunnel-Diode Characteristics.—Y. Furukawa. (*J. phys. Soc. Japan*, June 1960, Vol. 15, No. 6, p. 1130.) The temperature dependence of the maximum current was measured as a function of carrier concentration. Appreciable differences were observed between As- and Sb-doped samples. Results are briefly explained.

621.382.23 : 621.373.029.64/.65 359

Esaki-Diode Oscillators from 3 to 40 Gc/s.—R. Trambarulo & C. A. Burrus. (*Proc. Inst. Radio Engrs*, Oct. 1960, Vol. 48, No. 10, pp. 1776–1777.) The maximum power observed was 50 μW at 16·7 Gc/s using GaAs diodes.

621.382.3 360

Noise of Germanium and Silicon Transistors at High Current Densities.

—B. Schneider & M. J. O. Strutt. (*Arch. elekt. Übertragung*, Dec. 1959, Vol. 13, No. 12, pp. 495–502.) An equivalent circuit is derived for a *p-n* junction under high-current conditions, which comprises an inductance as well as resistances and capacitances. Formulae are obtained for shot noise which give results in good agreement with experimental values.

621.382.3 **361**

A Study of the Charge Control Parameters of Transistors.—J. J. Sparkes. (*Proc. Inst. Radio Engrs*, Oct. 1960, Vol. 48, No. 10, pp. 1696–1705.) The most significant performance parameters are considered to be the collector time-constant, the saturation time-constant, the 'on demand' current gain, the collector capacitance charge and the d.c. current gain. Their variation with d.c. level is considered.

621.382.3: 621.374.3 **362**

The Transistor as a Passive Circuit Element.—A. Darré. (*Frequenz*, Jan. 1960, Vol. 14, No. 1, pp. 6–10.) The use of transistors in alternating-voltage switching circuits and in logic circuits is considered.

621.382.3: 621.391.822 **363**

Shot and Thermal Noise in Germanium and Silicon Transistors at High-Level Current Injections.—B. Schneider & M. J. O. Strutt. (*Proc. Inst. Radio Engrs*, Oct. 1960, Vol. 48, No. 10, pp. 1731–1739.) A theoretical treatment is given for the case of shot noise at high current densities; formulae in good agreement with experimental values are obtained. A new equivalent circuit for *p-n* junctions is employed.

621.382.3.012.8 **364**

Equivalent Circuits of the Transistor used as a Linear Amplifier.—W. Benz. (*Elektronische Rundschau*, Jan. & Feb. 1960, Vol. 14, Nos. 1 & 2, pp. 5–9 & 59–64.) A review of equivalent circuits representing the idealized transistor and of simplified equivalent circuits for practical application.

621.382.3.078: 621.316.825 **365**

The Use of the Silicon Resistor in the D.C. Stabilization of Transistor Circuits.—D. H. Mehrtens, & J. T. Zakrewski. (*Electronic Engng*, Oct. 1960, Vol. 32, No. 392, pp. 624–629.) The properties are outlined and applications to both small-signal and power transistors are given.

621.382.33 **366**

Analytical Studies on Effects of Surface Recombination on the Current Amplification Factor of Alloy-Junction and Surface-Barrier Transistors.—T. Sugano & H. Yanai. (*Proc. Inst. Radio Engrs*, Oct. 1960, Vol. 48, No. 10, pp. 1739–1749.) Analytical formulae giving the survival factor of minority carriers are derived for various geometries of alloy-junction and similar transistors. Useful design data are obtained, such as the optimum radius ratio of the emitter electrode and the collector.

621.382.333 **367**

Matz Theory of the Junction Transistor at High Injection Levels.—M. Drăgănescu. (*J. Electronics Control*, June 1960, Vol. 8, No. 6, pp. 459–462.) A simplification of the Matz theory (1815 of 1960) is presented.

621.382.333.33 **368**

The Emitter Diffusion Capacitance of Drift Transistors.—J. Lindmayer & C. Wrigley. (*Proc. Inst. Radio Engrs*, Oct. 1960, Vol. 48, No. 10, pp. 1777–1778.) The relation between the capacitance calculated for the common-base configuration and that measured on the common-emitter configuration is determined.

621.382.333.33: 621.372.632 **369**

Parametric Amplification Properties in Transistors.—R. Zuleeg & V. W. Vodicka. (*Proc. Inst. Radio Engrs*, Oct. 1960, Vol. 48, No. 10, pp. 1785–1786.) See 4420 of 1960 (Vodicka & Zuleeg).

626.383.292 **370**

A Grid-Controlled Electron-Multiplier Tube.—D. C. Brown & M. F. Penny. (*J. Electronics Control*, June 1960, Vol. 8, No. 6, pp. 431–439.) "The properties of an experimental grid-controlled photomultiplier tube were investigated, and, under pulsed operation, a transfer conductance of 60 mA/V was achieved. The primary electron current was produced by placing a suitable scintillator near the photocathode and energizing it by means of a radioactive source of ^{90}Sr."

621.385.032.213.13 **371**

Electron Emission Current from Oxide-Coated Cathode subject to High Electric Field.—C. Shibata. (*J. phys. Soc. Japan*, June 1960, Vol. 15, No. 6, p. 1124.) The relation between current and applied field is found to differ experimentally from that of the Schottky effect.

621.385.032.213.13: 621.317.332 **372**

A New Method for the Measurement of Cathode Interface Impedance.—J. Tamiya. (*Rev. sci. Instrum.*, July 1960, Vol. 31, No. 7, pp. 696–700.) The valve containing the cathode interface impedance to be measured, forms a bridge with a reference valve and a variable *RC* circuit. Measurement is made by balancing simultaneously at 200 kc/s, 1·1 and 5 Mc/s.

621.385.032.213.13: 621.317.332 **373**

Nonlinear Effect upon the Equivalent Circuit of Interface Impedance in Pulse Methods.—J. Tamiya. (*Rev. sci. Instrum.*, July 1960, Vol. 31, No. 7, pp. 786–788.) A quantitative analysis of the effect of nonlinear valve characteristics and rectification in the cathode layers. These introduce spurious *RC* elements in the equivalent circuit.

621.385.1.004.6 **374**

Mathematical and Statistical Methods of Considering Lifetime Data and their Application to Thermionic Valves.—A. Deixler & E. Rusch. (*Nachrichtentech. Z.*, Dec. 1959, Vol. 12, No. 12, pp. 613–618.) The validity of a mathematical law of lifetime is examined on the basis of a statistical model test. A comparison with actual valve life data leads to the proposal of simplified statistical reliability concepts.

621.385.623.5: 621.376.23.029.65 **375**

Use of Reflex Klystrons as Millimetre-Wave Detectors.—K. Ishii. (*Electronics*, 9th Sept. 1960, Vol. 33, No. 37, pp. 82–83.) A gain of 12 dB over conventional crystal detectors can be obtained when the klystron is used as a regenerative detector.

621.385.624 **376**

Instability Effects in High-Power C.W. Klystrons.—J. C. Vokes & C. P. Lea-Wilson. (*J. Electronics Control*, June 1960, Vol. 8, No. 6, pp. 401–419.) Instability effects observed in a four-cavity 2-kW X-band klystron amplifier with an efficiency of 40% are described. An explanation is given accounting for all the major effects observed.

621.385.63: 621.375.9: 621.372.44 **377**

The D.C. Pumped Quadrupole Amplifier—a Wave Analysis.—A. E. Siegman. (*Proc. Inst. Radio Engrs*, Oct. 1960, Vol. 48, No. 10, pp. 1750–1755.) An analysis is given of the electron-beam amplifier which is pumped by direct voltage via a twisted quadrupole structure. Amplification is found to result from the coupling of the slow and fast cyclotron waves. The device appears promising as a microwave amplifier.

621.385.632.19: 621.372.853 **378**

Nonperiodic Slow-Wave and Backward-Wave Structures.—Clarricoats & Waldron. (See 33.)

621.385.633.14 **379**

Parasitic Modulation Phenomena in Long-Beam Tubes of the Carcinotron O Type.—D. Reverdin. (*Ann. Radioélect.*, April 1960, Vol. 15, No. 60, pp. 147–168. English abridgment pp. 203–204.) Results of an experimental investigation show that ionic plasma oscillations are the source of spurious modulation effects. These effects may be reduced by (*a*) improving the vacuum, (*b*) using ion and slow-electron traps.

MISCELLANEOUS

621.37/.38: 539.12.04 **380**

Radiation Pulses and Electronics.—J. W. Clark & T. D. Hanscome. (*Nucleonics*, Sept. 1960, Vol. 18, No. 9, pp. 74–77.) The effects of radiation pulses acting on electronic components are considered. A distinction is made between ionization and atomic displacement effects, and the general design principles for radiation-resistant circuits are outlined.

Abstracts and References

COMPILED BY THE RADIO RESEARCH ORGANIZATION OF THE DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH AND PUBLISHED BY ARRANGEMENT WITH THAT DEPARTMENT

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ACOUSTICS AND AUDIO FREQUENCIES

534.21-14 **381**

Sound Source near a Velocity Discontinuity.—P. Gottlieb. (*J. acoust. Soc. Amer.*, Sept. 1960, Vol. 32, No. 9, pp. 1117–1122.) The far-field solution for a line and a point source near a tangential velocity discontinuity has been calculated by summing the plane waves that make up the source.

534.23-14 **382**

Underwater Explosions as Acoustic Sources.—D. E. Weston. (*Proc. phys. Soc.*, 1st Aug. 1960, Vol. 76, No. 488, pp. 233–249.) The special nature of the underwater explosion as an acoustic source is considered and some absolute charge source levels and measured differences between the acoustic source levels of charges of various size are given in tabular form.

534.26 + [538.566: 535.42 **383**

Diffraction of a Pulse by a Reactive Half-Plane.—Papadopoulos. (See 503.)

534.26 **384**

Acoustic Forces and Torques on a System of Strips.—K. Saenmark. (*Ann. sci. Rec.*, 1959, Vol. 80, No. 1, pp. 15–28.) In continuation of earlier theoretical work on the scattering of e.m. waves by strips, the acoustic forces are calculated for the diffraction of a plane acoustic wave at a system of two right coplanar strips. See 100 below.

534.286-8 **385**

Ultrasonic Absorption and Velocity in Molten Salts.—R. W. Biggs & T. A. Litovitz. (*J. acoust. Soc. Amer.*, Sept. 1960, Vol. 32, No. 9, pp. 1108–1115.) Measurements made on a series of molten nitrate salts indicate a structural viscosity similar to that found in water and associated organic liquids.

534.614-8-14 **386**

Measurement of the Speed of Sound across Thin Sheets of Plastic Material. Use for the Interferential Determination of the Speed of Sound in Liquids.—G. Laville & J. Maillet. (*C. R. Acad. Sci., Paris*, 15th Feb. 1960, Vol. 250, No. 7, pp. 1206–1207.)

534.75 **387**

Theory of Signal Detectability as an Interpretive Tool for Psychophysical Data.—W. P. Tanner, Jr. (*J. acoust. Soc. Amer.*, Sept. 1960, Vol. 32, No. 9, pp. 1140–1147.)

534.76 **388**

An Energy Theory of Directional Hearing and its Applications in Stereophony.—H. Mertens. (*E.B.U. Rev.*, Feb. 1960, No. 59A, pp. 22–33.) A general formula for the transfer function of any two-channel system of stereophony is derived and applied to two practical systems.

534.76: 061.3 **389**

Conference on Problems of Stereophony, held at the Institut für Rundfunktechnik in Hamburg, 5th and 6th April 1960.—*Rundfunktech. Mitt.*, Aug. 1960, Vol. 4, No. 4, pp. 161–178.) The abridged text is given of papers dealing with stereophonic and pseudostereophonic systems, stereophonic recording and reproduction methods, and related broadcasting problems.

534.76: 621.396.97 **390**

Perspectives for 'Room-Related' Broadcast Transmission.—L. Keibs. (*Tech. Mitt. RRF, Berlin*, March 1960, Vol. 4, No. 1, pp. 2–20.) The subjective and objective parameters which affect auditory perspective are discussed with particular reference to the simulation of concert-hall or studio listening conditions at the receiver. Stereophonic broadcasting and recording techniques are reviewed. 85 references.

534.793 **391**

The Usual and Necessary Dynamic Characteristics of Objective Loudness Meters.—H. Niese. (*Hochfrequenztech. u. Elektroakust.*, Feb. 1960, Vol. 69, No. 1, pp. 17–29.)

534.833.4: 621.372.51 **392**

Determining Component Variation for Gradual Transition between Dissimilar Impedances.—Becker, Bruce & Turner. (See 454.)

534.84 **393**

A New Large Anechoic Chamber for Sound Waves.—W. Kraak, G. Jahn & W. Fandel. (*Hochfrequenztech. u. Elektroakust.*, Feb. 1960, Vol. 69, No. 1, pp. 1–7.) The dimensions of the chamber are 23 m × 11 m × 8 m high; special precautions to exclude external noise have been taken, and the reflection factor does not exceed 10%, in the frequency range 100 c/s–12 kc/s.

621.395.625.3 : 539.221 394

The Anhysteretic Remanence of Magnetic Recording Tapes.—Wohlfarth. (See 455.)

AERIALS AND TRANSMISSION LINES

621.315.212 : 537.312.62 395

Resonance Response and Accumulation Characteristics of a Superconductive Coaxial Line.—N. S. Nahman & G. M. Gooch. (*Proc. Inst. Radio Engrs*, Nov. 1960, Vol. 48, No. 11, pp. 1852–1856.) Description of a miniature superconducting line which transmits nanosecond pulses without measurable change in rise time. Data on temperature dependence over a wide range are given.

621.372.2 396

A Variational Integral for Propagation Constant of Lossy Transmission Lines.—R. E. Collin. (*Trans. Inst. Radio Engrs*, May 1960, Vol. MTT-8, No. 3, pp. 339–342. Abstract, *Proc. Inst. Radio Engrs*, Aug. 1960, Vol. 48, No. 8, p. 1515.)

621.372.2 : 621.3.018.756 397

Analysis of Certain Transmission-Line Networks in the Time Domain.—W. J. Getsinger. (*Trans. Inst. Radio Engrs*, May 1960, Vol. MTT-8, No. 3, pp. 301–309. Abstract, *Proc. Inst. Radio Engrs*, Aug. 1960, Vol. 48, No. 8, p. 1515.)

621.372.2 : 621.372.5 398

Reactance Circuits consisting of Electromagnetically Coupled Lines in Decimetre-Wave Applications.—O. Gold. (*Nachrichtentech. Z.*, Jan. 1960, Vol. 13, No. 1, pp. 15–23.) The circuit equations of coupled transmission-line systems and their equivalent circuits are derived and parameters tabulated. The design of coupled strip- and coaxial-line filters and directional couplers is described.

621.372.2 : 621.372.51 399

A Printed-Circuit Balun for Use with Spiral Antennas.—R. Bawer & J. J. Wolfe. (*Trans. Inst. Radio Engrs*, May 1960, Vol. MTT-8, No. 3, pp. 319–325. Abstract, *Proc. Inst. Radio Engrs*, Aug. 1960, Vol. 48, No. 8, p. 1515.)

621.372.8 : 534.29 400

Microphony in Waveguide.—I. Goldstein & S. Soorsoorian. (*Trans. Inst. Radio Engrs*, May 1960, Vol. MTT-8, No. 3, pp. 372–375. Abstract, *Proc. Inst. Radio Engrs*, Aug. 1960, Vol. 48, No. 8, p. 1516.)

621.372.8.002.2 401

Electroformed Copper Waveguides.—L. E. Hall & B. H. Meggs. (*Metal Ind., Lond.*, 25th Nov. 1960, Vol. 97, No. 22, pp. 435–438.) The process of electroforming and its advantages are outlined.

621.372.821 402

Radiation from Discontinuities in Strip-Line.—L. Lewin. (*Proc. Instn elect. Engrs*, Part C, Sept. 1960, Vol. 107, No. 12, pp. 340–349.) The calculations, for unscreened strip-line, include the effects due to open and short circuits, coaxial connections, posts and corners.

621.372.821 403

Discontinuities in the Known Character of Symmetric Strip Transmission Line.—H. M. Altschuler & A. A. Oliner. (*Trans. Inst. Radio Engrs*, May 1960, Vol. MTT-8, No. 3, pp. 328–339. Abstract, *Proc. Inst. Radio Engrs*, Aug. 1960, Vol. 48, No. 8, p. 1515.)

621.372.821 : 621.372.832.8 404

A Y-Junction Strip-Line Circulator.—L. Milano, J. H. Saunders & L. Davis, Jr. (*Trans. Inst. Radio Engrs*, May 1960, Vol. MTT-8, No. 3, pp. 346–351. Abstract, *Proc. Inst. Radio Engrs*, Aug. 1960, Vol. 48, No. 8, p. 1516.)

621.372.823 : 621.372.831 405

A Method for the Evaluation of Equivalent-Circuit Parameters of an Asymmetric Waveguide Junction.—J. K. Sinha. (*Proc. Instn elect. Engrs*, Part C, Sept. 1960, Vol. 107, No. 12, pp. 324–329.) Parameters derived by considering only the first few evanescent modes agree very well with those obtained experimentally using a cavity system partially filled with coaxial dielectric rod.

621.372.826 : 537.226 406

Power Flow and Negative Wave Impedance in the Dielectric-Rod Waveguide.—E. F. F. Gillespie. (*Proc. Instn elect. Engrs*, Part C, Sept. 1960, Vol. 107, No. 12, pp. 198–201.) A general theory of power flow is derived for a hybrid mode.

621.372.831.11 407

Nonreflecting Waveguide Tapers.—H. E. M. Barlow. (*Proc. Instn elect. Engrs*, Part B, Nov. 1960, Vol. 107, No. 36, pp. 515–521.) An exact match is theoretically possible if a change in position of the wall of a waveguide is accompanied by an appropriate change of surface impedance. The idea is developed in detail for a linear taper.

621.372.832.4 408

Some Observations on Waveguide Coupling through Medium-Sized Slots.—L. Lewin. (*Proc. Instn elect. Engrs*, Part C, Sept. 1960, Vol. 107, No. 12, pp. 171–178.) A quasistatic method is used taking radiation damping into account. Details are given for axially-coupled waveguides, and for waveguides coupled through crossed slots in the broad face.

621.372.832.4 409

Two Capacitive Windows in a Rectangular Waveguide.—H. Bosma. (*Appl. sci. Res.*, 1958, Vol. B7, No. 2, pp. 131–144.) An investigation of the behaviour of two apertures located a small distance apart in relation to wavelength and with their edges parallel to the long side of the waveguide. Expressions for the reflection and transmission coefficients are given and absolute values of the transmission coefficient are obtained both theoretically and experimentally.

621.372.852.3 410

Transmission-Line Electrograph Systems Limited's Ultra-Violet Transfer of Engineering Drawings.—(See 464.)

621.372.852.323 411

The Physical Mode of Operation and the Theory of Faraday Resonance Isolators.—R. Strelzer. (*Nachrichtentech. Z.*, March 1960, Vol. 13, No. 3, pp. 119–126.) The principle of ferromagnetic resonance absorption is compared with the aid of a model. Maxwell's equations are used in calculating directional attenuation and phase shift of isolators.

621.372.852.3 412

A New H_{11}-to-H_{01} Mode Transducer.—C. C. Eaglefield, Y. Klinger & L. Solymar. (*Proc. Instn elect. Engrs*, Part B, Nov. 1960, Vol. 107, No. 36, pp. 512–514.) The H_{01} mode of a circular waveguide can be excited from the H_{10} mode of a rectangular waveguide, via a transducer for the H_{20} rectangular-waveguide mode. Construction of the latter is described, based on a general method given by Barlow (*ibid.*, 1959, Vol. 106, Supplement 13, pp. 1–8).

621.396.67 413

Communal Aerials.—K. E. Müller & G. Martin. (*NachrTech.*, Jan. 1960, Vol. 10, No. 1, pp. 14–21.) Continuation of 2227 of 1960 (Düniss & Müller) with details of measurements of reflection coefficient and voltage distribution on aerial installations.

621.396.67 : 621.317.3 414

Practical Aerial Measurements.—F. C. Judd. (*Wireless World*, Dec. 1960, Vol. 66, No. 12, pp. 580–584.) A scale model for plotting vertical and horizontal aerial radiation patterns is described. Circuit diagrams of a suitable 3-Gc/s oscillator and receiver are given, with the radiation patterns obtained for various types of aerials.

621.396.67 : 621.391.81.029.63 415

The Height Gain of Receiving Aerials for Band IV with Horizontal Polarization.—P. Thiessen. (*Rundfunktech. Mitt.*, Aug. 1959, Vol. 3, No. 4, pp. 196–202.) The relation between the height-gain function and the type of terrain is established on the basis of measurements. The results obtained enable field-strength values measured at any height between 3 and 10 m to be converted to the standard height of 10 m.

621.396.67.095.1 : 530.17 416

On Determining the Polarization Orientation Angle of a Linearly Polarized Source by Analogue Techniques.—R. E. Franks & R. L. Bell. (*Proc. Inst. Radio Engrs*, Nov. 1960, Vol. 48, No. 11, pp. 1919–1920.) Three 120° spaced probes in a conical horn aerial are used to indicate polarization angle of a source on the rotor of a torque generator.

621.396.677.83 [illegible]

Transients in Cylindrical Antennas.—[illegible] (*Proc. Instn elect. Engrs*, Part C, Sept. 1960, Vol. 107, No. 12, pp. 296–306.) An analysis of the transient response of the radiation field for step-function excitation, with experimental confirmation.

621.396.67.029.5 [illegible]

Voltage Breakdown of Antennas at High Altitudes.—[illegible] (*Proc. Instn elect. Engrs*, Part C, Sept. 1960, Vol. 107, No. 12, pp. 289–295.) A consideration of the mechanism responsible for breakdown is followed by the presentation of experimental data illustrating breakdown power as a function of altitude for different aerials under [illegible] conditions. Methods of increasing power-handling capacity are also discussed.

621.396.677.1.029.52/.53 [illegible]

The Resonance Excitation of a Corrugated-Cylinder Antenna.—J. G. Wait & A. M. Conda. (*Proc. Instn elect. Engrs*, Part C, Sept. 1960, Vol. 107, No. 12, pp. 362–368.) Radiation from an axial magnetic line or slot source on the surface of a corrugated cylinder is considered. The analysis is extended to an elliptic cylinder with a special azimuthal variation of surface reactance, which can be adapted to study a corrugated panel on a flat metallic ground plane excited by a parallel slot source.

621.396.677 : 621.372.826 **420**

The Surface-Wave Aerial.—W. Hersch. (*Proc. Instn elect. Engrs*, Part C, Sept. 1960, Vol. 107, No. 12, pp. 202–212.) Surface-waveguide theory is extended to include higher-order hybrid modes and applied to the design of a high-gain endfire aerial small compared with the wavelength.

621.396.677.43 **421**

Rhombic Aerials with Optimum Operating Characteristics.—P. Miram & E. Palm. (*Nachrichtentech. Z.*, Feb. 1960, Vol. 13, No. 2, pp. 82–91.) Improved design formulae are derived and aerial parameters are given as a function of input impedance in tabular and graphical form. The design of a wide-band rhombic with changing angle of taper (exponential rhombic) is discussed.

621.396.677.5 **422**

Extension of the Range of Validity of a Calibration Method for Frame Aerials.—E. Zühlke. (*NachrTech.*, Jan. 1960, Vol. 10, No. 1, pp. 21–23.) Swinyard's equation is modified by a correction factor to make it applicable for any ratio l/λ where l is the distance between transmitter and receiver aerials.

621.396.677.71 **423**

An Experimental Study of the Slot Aerial and the Three-Element Collinear Array of Slot Aerials.—R. King & G. H. Owyang. (*Proc. Instn elect. Engrs*, Part C, Sept. 1960, Vol. 107, No. 12, pp. ?16–227.) The circuit properties of slot aerials centre-fed by two-slot transmission lines are investigated; the results are compared with the theoretically derived complementary quantities for a cylindrical dipole aerial.

621.396.677.83 [illegible]

The Backfire Antenna.—R. Pleasance. (*Proc. Instn elect. Engrs*, Part C, Sept. 1960, Vol. 107, No. 12, pp. 309–317.) A new explanation is advanced for the resonant directivity of backfire [illegible] aerials.

621.396.677.029.6 **425**

A New Design Method for Phase-Corrected Reflectors at Millimetre Frequencies.—R. Pleasance. (*Proc. Instn elect. Engrs*, Part C, Sept. 1960, Vol. 107, No. 12, pp. 179–186.) This discussion was enclosed for reading the reflector surface with a dielectric, which may be an array of metal plates or waveguides. Experimental results are given for 8·6 Gc/s.

621.396.677.833.2 **426**

Conditions for Surface Excitation.—A. B. Pleasance, G. F. Pycroft & D. Sledgers. (*Proc. Instn elect. Engrs*, Part B, Nov. 1960, Vol. 107, No. 36, pp. 567–572.) An analysis, applicable to steep paraboloids, for a dipole placed at the focus along the axis of rotation. The field well along the axis is not important when two similar systems are coupled at close range.

621.396.677.833.2 **427**

Wide-Band Paraboloidal Aerials with Helices as Radiators for Decimetre Waves.—R. Herz. (*Nachrichtentech. Z.*, March 1960, Vol. 13, No. 3, pp. 109–114.) Investigations were made on 2-m and 3-m paraboloidal reflectors illuminated by helix radiators with a special matching arrangement. Gain and radiation patterns are given for circular polarization at frequencies in the range 610–960 Mc/s.

621.396.677.833.2 **428**

Monitoring Paraboloidal Reflector Antennas.—G. Swarup & K. S. Yang. (*Proc. Inst. Radio Engrs*, Nov. 1960, Vol. 48, No. 11, pp. 1918–1919.) A method is described for monitoring surface distortions.

621.396.677.85 **429**

Phase Change on Transmission of Microwaves through Metal Disc Delay Dielectrics.—C. Dhanalakshmi & S. K. Chatterjee. (*Z. Phys.*, 18th Feb. 1960, Vol. 158, No. 2, pp. 196–203. In English.) The theoretical phase change is derived for microwave transmission through an artificial dielectric composed of metal disks arranged in a three-dimensional array. Experimental values obtained on arrays with disk spacings of 1·91 and 2·22 cm are given for comparison.

621.396.677.85 **430**

The Electromagnetic Theory of the Spherical Luneberg Lens.—C. T. Tai. (*Appl. sci. Res.*, 1958, Vol. B7, No. 2, pp. 113–130.) A solution is obtained for the spherical or three-dimensional Luneberg lens.

621.396.677.85 : 621.396.933.2 **431**

The Design of Cylindrical Metal-Plate Microwave Lenses fed by Non-resonant Slotted Waveguide Arrays.—J. W. Crompton. (*Proc. Instn elect. Engrs*, Part C, Sept. 1960, Vol. 107, No. 12, pp. 330–333.) "The use of a suitably modified refractive index enables cylindrical lenses [illegible]

AUTOMATIC COMPUTERS

681.142 **432**

A High-Speed Adding System.—N. Kyan-[illegible] (*Proc. Joint Comput. Conf., Japan*, March/April 1960, Vol. II, Nos. 3–6, pp. 171–180.) A new system is described which increases the adding speed by obtaining the 'carries' of all digits in a one-step operation.

681.142 **433**

A Digital Computer Store with Very Short Read Time.—T. Kilburn & R. L. Grimsdale. (*Proc. Instn elect. Engrs*, Part B, Nov. 1960, Vol. 107, No. 36, pp. 367–372. Discussion, pp. 605–607.) Each binary cell is formed by two sets of windings coupled, or not coupled, by a linear ferrite. A 200 000-unit store has been constructed.

681.142 **434**

A Parallel Arithmetic Unit using a Saturated-Transistor Fast-Carry Circuit.—T. Kilburn, D. B. G. Edwards & D. Aspinall. (*Proc. Instn elect. Engrs*, Part B, Nov. 1960, Vol. 107, No. 36, pp. 573–584. Discussion, pp. 605–607.) An addition time over 24 digits of 200 ns is achieved.

681.142 **435**

Multipliers and Dividers in A.C. Computers.—C. H. Smith & A. Prabhakar. (*Electronic Engng*, Nov. 1960, Vol. 32, No. 393, pp. 714–716.) Thermionic-valve and transistor dividers and multipliers are described in which the exponential shape of the small-signal characteristic is used to combine a d.c. and an a.c. signal.

681.142 **436**

The Differential Analyser and its Realization in Digital Form.—P. L. Owen, M. F. Partridge & T. R. H. Sizer. (*Electronic Engng*, Oct. & Nov. 1960, Vol. 32, Nos. 392 & 393, pp. 614–617 & 700–704.)

681.142 : 537.376 **437**

High-Speed Light Output Signals from Electroluminescent Storage Systems.—G. R. Hoffman, D. H. Smith & D. C. Jeffreys. (*Proc. Instn elect. Engrs*, Part B, Nov. 1960, Vol. 107, No. 36, pp. 599–605. Discussion, pp. 605–607.) The effect of phosphor afterglow (25–30 μs per digit) on read-out time appears to limit the number of matrices to about 32 × 32.

681.142 : 538.221 : 539.23 **438**

A Computer Storage Matrix using Ferromagnetic Thin Films.—E. M. Bradley. (*J. Brit. Instn Radio Engrs*, Oct. 1960, Vol. 20, No. 10, pp. 765–784.) Details are given of the construction and performance of a storage system using the coherent

rotational mode of magnetization reversal in thin films of a newly developed alloy on an Al substrate.

681.142 : 621.318.134 **439**

A 1-Mc/s Magnetic-Core Buffer Store for Use with a Card Punch or Line Printer.—J. B. James. (*Electronic Engng*, Nov. 1960, Vol. 32, No. 393, pp. 689–695.) The store accepts data from a computer and provides a series of parallel outputs suitable for a printer or card punch. Square-loop magnetic cores are used and the decoding and parity-check circuits are described.

681.142 : 621.318.134 **440**

Ferrite-Core Memory Systems with Rapid Cycle Times.—D. B. G. Edwards, M. J. Lanigan & T. Kilburn. (*Proc. Instn elect. Engrs*, Part B, Nov. 1960, Vol. 107, No. 36, pp. 585–598. Discussion, pp. 605–607.) The normal cycle time of 6–10 μs for square-loop ferrite cores is reduced to 2 μs. A system suitable for a store of 1 024 words of 52 digits with a cycle time of 1·6 μs is developed.

681.142 : 621.318.134 : 621.318.57 **441**

A Class of Optimal Noiseless Load-Sharing Matrix Switches.—R. T. Chien. (*IBM J. Res. Developm.*, Oct. 1960, Vol. 4, No. 4, pp. 414–417.) A scheme for constructing a matrix switch with a reduced number of input wires is given. See also 442 below.

681.142 : 621.318.134 : 621.318.57 **442**

New Developments in Load-Sharing Matrix Switches.—G. Constantine, Jr. (*IBM J. Res. Developm.*, Oct. 1960, Vol. 4, No. 4, pp. 418–422.) See also 3712 of 1958.

681.142 : 621.372.44 **443**

The Parametron and its Application in Data Processing Systems.—E. Schmitt. (*Elektronische Rundschau*, Feb. 1960, Vol. 14, No. 2, pp. 41–46.) Ferrite-core and diode parametrons are reviewed and applications are discussed.

681.142 : 621.374.5 : 538.652 **444**

Transistorized Magnetostrictive Delay-Line Stores.—H. A. Showell, C. W. M. Barrow & R. E. Collis. (*AEI Engng Rev.*, July 1960, Vol. 1, No. 2, pp. 58–67.) Two types of storage system for operation at 1 Mc/s are described; their delay times are 100 μs and 1 ms respectively. See also *Proc. Inst. elect. Engrs*, Part B, April 1960, Vol. 106, Supplement No. 18, pp. 1267–1276.

681.142 : 621.395.625.3 **445**

The Assessment of the Reliability of Magnetic Tape for Data Processing.—R. Noble. (*J. Brit. Instn Radio Engrs*, Oct. 1960, Vol. 20, No. 10, pp. 737–742.) A method of tape testing based on a theory of the origin of observed signal drop-out distribution permits batch testing and assists in the design of tape-handling systems and in the calculation of reliability.

681.142 : 621.395.625.3 **446**

A Magnetic Read Head with Output Signal Independent of Tape Speed.—D. Kerr & E. J. M. Quirk. (*J. Brit. Instn Radio Engrs*, Oct. 1960, Vol. 20, No. 10, pp. 743–748.) Each head is double, consisting of a variable-reluctance reading head and a conventional writing head. One unit comprises eight double heads and can be used with standard ½-in. tape in computer output and editing equipments. The reading head is adequate for normal packing densities over a wide range of tape speeds down to zero.

CIRCUITS AND CIRCUIT ELEMENTS

621.319.4 **447**

Self-Resonance of Ceramic Miniature Capacitors.—K. H. Olbricht. (*Bull. schweiz. elektrotech. Ver.*, 27th Feb. 1960, Vol. 51, No. 4, pp. 142–147.) Methods of measuring the resonance frequency are discussed and the characteristics of various types of miniature ceramic capacitor at frequencies in the range 10–1 000 Mc/s are investigated. See also 3362 of 1958 (Bork).

621.372.4/.5 **448**

A Review of the Present State of Network Synthesis: Part 1.—G. Wunsch. (*Frequenz*, Feb. 1960, Vol. 14, No. 2, pp. 47–55.) Comprehensive review of synthesis methods. 40 references.

621.372.4 **449**

Two-Terminal *RC* Networks and Theoretically Related Topics.—O. P. D. Cutteridge. (*Proc. Instn elect. Engrs*, Part C, Sept. 1960, Vol. 107, No. 12, pp. 275–282.) A derivation of the properties of the principal minors of successive orders of the nodal determinant of a lumped linear *RC* network. See also 661 below.

621.372.413 **450**

Perturbation Theory of Resonant Cavities.—R. A. Waldron. (*Proc. Instn elect. Engrs*, Part C, Sept. 1960, Vol. 107, No. 12, pp. 272–274.) A detailed derivation is given of the perturbation formula for the frequency shift on introducing a sample of ferrite or dielectric material into a resonant cavity.

621.372.413 **451**

On the Theory of Strongly Coupled Cavity Chains.—M. A. Allen & G. S. Kino. (*Trans. Inst. Radio Engrs*, May 1960, Vol. MTT-8, No. 3, pp. 362–372. Abstract, *Proc. Inst. Radio Engrs*, Aug. 1960, Vol. 48, No. 8, p. 1516.)

621.372.413 : 546.824-31 **452**

The Rutile Microwave Resonator.—A. Okaya. (*Proc. Inst. Radio Engrs*, Nov. 1960, Vol. 48, No. 11, p. 1921.) The use of a rutile crystal as a microwave resonant cavity is described. This is of a much smaller size than the equivalent metal-walled cavity.

621.372.413 : 621.317.61 **453**

Measurement of Bandwidth of Microwave Resonator by Phase Shift of Signal Modulation.—D. S. Lerner & H. A. Wheeler. (*Trans. Inst. Radio Engrs*, May 1960, Vol. MTT-8, No. 3, pp. 343–345. Abstract, *Proc. Inst. Radio Engrs*, Aug. 1960, Vol. 48, No. 8, pp. 1515–1516.)

621.372.51 : 534.833.4 **454**

Determining Component Variation for Gradual Transition between Dissimilar Impedances.—C. Becker, C. M. Bruen & R. B. Turner. (*IBM J. Res. Developm.*, Oct. 1960, Vol. 4, No. 4, pp. 430–438.) The problem is attacked by a recursive method needing a minimum of numerical precision. The application to an acoustic absorption system is considered [see also 2013 of 1957 (Becker)].

621.372.54 **455**

Remarks on the Additions to Küpfmüller's Transient Formula.—G. Wunsch. (*Hochfrequenztech. u. Elektroakust.*, Feb. 1960, Vol. 69, No. 1, pp. 35–39.) Küpfmüller's formula for low-pass filters is generalized and an analogous formula valid for all-pass delay circuits with optimally flat response is derived.

621.372.54 **456**

The Performance of Filter Networks consisting of *n* Equal Half-Sections.—W. Herzog. (*Nachrichtentech. Z.*, March 1960, Vol. 13, No. 3, pp. 137–146.) Formulae are given for the open-circuit impedance of an *n*-section network from which the transmission characteristics can be derived. Calculations for various simple filters are included.

621.372.54 : 534.1 **457**

A 400-c/s Tuning-Fork Filter.—J. J. O'Connor. (*Proc. Inst. Radio Engrs*, Nov. 1960, Vol. 48, No. 11, pp. 1857–1865.) An introduction to the use of a tuning-fork filter as a circuit element and a complete description of a particular unit, its derivation and the correlation between theory and measurement.

621.372.54 : 621.374.5 **458**

Linear-Slope Delay Filters for Compression.—T. R. O'Meara. (*Proc. Inst. Radio Engrs*, Nov. 1960, Vol. 48, No. 11, pp. 1916–1918.) Design considerations are summarized for filters having linear change of delay time with frequency over a narrow band.

621.372.57 : 681.142 **459**

The Normalization of Electrical Integrating and Differentiating Circuits.—K. H. Kerber. (*Elektronische Rundschau*, Feb. 1960, Vol. 14, No. 2, pp. 49–50.) See also 3401 of 1960.

621.373 : 621.372.44 **460**

On the Switching Time of Subharmonic Oscillators.—A. H. Nethercot, Jr. (*IBM J. Res. Developm.*, Oct. 1960, Vol. 4, No. 4, pp. 402–406.) The time necessary to change the phase of an idealized subharmonic parametric oscillator by 180° is calculated for various values of pump power and switching power.

621.373.4 **461**

Qualitative Investigation of a New Oscillator Circuit.—S. Vojtášek & K. Janáč. (*Hochfrequenztech. u. Elektroakust.*, Feb. 1960, Vol. 69, No. 1, pp. 11–17.) Analysis of a triode oscillator circuit with good frequency stability by (*a*) mathematical treatment and (*b*) an analogue differential analyser.

621.373.52 **462**

Transistor Beta-Phase-Shift Oscillator.—A. R. Saha. (*J. Electronics Control*, Aug. 1960, Vol. 9, No. 2, pp. 113–125.) A new oscillator circuit is described whose performance is analysed theoretically and confirmed by experiment.

621.374: 621.372.44: 621.382.23 **463**

Pulse Shaping with Variable-Capacitance Diodes.—D. P. Schulz. (*Proc. Inst. Radio Engrs*, Nov. 1960, Vol. 48, No. 11, p. 1918.) Small-signal analysis is carried out for variable-capacitance integrating and differentiating circuits.

621.374.32 **464**

Multiple Coincidence Circuit.—R. L. Chase. (*Rev. sci. Instrum.*, Sept. 1960, Vol. 31, No. 9, pp. 945–949.) A general-purpose transistor coincidence circuit accepting up to five input signals with three simultaneous outputs is described. It features a special discriminator which operates on the leading edge of the input signals or the passage through zero on the trailing edge; the discriminator bias can be varied over a wide range without affecting the circuit recovery time.

621.374.32 **465**

High-Speed Counter requiring No Carry Propagation.—W. N. Carroll. (*IBM J. Res. Developm.*, Oct. 1960, Vol. 4, No. 4, pp. 423–425.) The method depends on forming complements, but the need for complementing the entire register is eliminated.

621.374.5: 621.382.3 **466**

Highly Accurate Phantastron Delay Circuit.—S. R. Parris & D. A. Staar. (*Electronics*, 21st Oct. 1960, Vol. 33, No. 43, pp. 72–74.) A transistor circuit incorporates compensating arrangements to cancel sources of timing error. The final circuit provides a delay of 220 μs with an accuracy within $\pm 1\%$.

621.375.018.756 **467**

The Laws of Summation for Tilt, Rise Time and Overshoot, particularly in Amplifier Circuits.—H. Dobesch & H. Sulanke. (*NachrTech.*, Jan. 1960, Vol. 10, No. 1, pp. 3–14.) The time-function parameters of pulses applied to cascade-connected quadripoles are calculated. An improved summation law for the rise time is derived.

621.375.018.756 **468**

The Representation in Pulse Form of the Noise of Amplifiers.—H. Maier-Leibnitz. (*Z. angew. Phys.*, March 1960, Vol. 12, No. 3, pp. 97–99.) The noise characteristics of pulse amplifiers are derived, without reference to the frequency spectrum, as a function of the pulse response of the amplifier.

621.375.132 **469**

Amplifiers with Quasi-constant Gain.—J. T. Allanson. (*Electronic Technol.*, Dec. 1960, Vol. 37, No. 12, pp. 462–466.) Various methods are considered whereby the overall gain of an amplifying system may be held approximately constant despite variations in the parameters of the amplifying units incorporated in the system.

621.375.232.3 **470**

Ultralinear Cathode Follower.—P. L. Read. (*Rev. sci. Instrum.*, Sept. 1960, Vol. 31, No. 9, pp. 979–982.) Six valves are used in a modified White follower circuit to give unity gain, an output impedance of $2 \times 10^{-3}\ \Omega$ and intermodulation distortion $2 \times 10^{-5}\%$.

621.375.3 **471**

Flux Resetting Characteristics of Full-Wave Magnetic Amplifier affected by the Metallic Rectifier.—K. Murakami & T. Kikuchi. (*Sci. Rep. Res. Inst. Tohoku Univ., Ser. B*, 1959, Vol. 11, No. 1, pp. 23–44.) Quantitative relations between rectifier and flux resetting characteristics are investigated by a technique in which the effects of nonlinear forward and reverse characteristics of the rectifier are separated by means of mechanical synchronous contacts.

621.375.3.024: 621.375.4 **472**

A High-Power Transistor-Magnetic D.C. Amplifier.—G. Sarkar. (*Electronic Engng*, Nov. 1960, Vol. 32, No. 393, pp. 705–711.) The amplifier uses a transistor chopper, two transistor amplifiers and a magnetic amplifier. The circuits described give a high gain, high power output and high input impedance.

621.375.421 **473**

Transistor Wide-Band Amplifiers.—A. I. Fischer. (*NachrTech.*, Feb. 1960, Vol. 10, No. 2, pp. 83–87.) The design of *RC*-coupled multistage amplifiers is considered; only the earthed-emitter configuration is suitable for this application.

621.375.9: 538.569.4 **474**

Atomic Hydrogen Maser.—H. M. Goldenberg, D. Kleppner & N. F. Ramsey. (*Phys. Rev. Lett.*, 15th Oct. 1960, Vol. 5, No. 8, pp. 361–362.) Self-sustained emission at the atomic-hydrogen hyperfine transition frequency has been observed. Increased interaction times with the radiation field (mean values up to 0·3 sec) and correspondingly narrowed resonance widths have been obtained by retaining the atoms in a storage box with suitable walls. Stimulated emission has also been recorded and the magnetic-field-independent hyperfine transition used to observe field-dependent Zeeman transitions by a double resonance method.

621.375.9: 621.372.44 **475**

Parametric Amplifiers.—R. Ebner, L. Pungs & K. H. Steiner. (*Frequenz*, Feb. 1960, Vol. 14, No. 2, pp. 59–67.) A review of nonlinear-reactance circuits; amplifier characteristics are calculated and compared with experimental results.

621.375.9: 621.372.44 **476**

An Analysis of Four-Frequency Nonlinear Reactance Circuits.—D. K. Adams. (*Trans. Inst. Radio Engrs*, May 1960, Vol. MTT-8, No. 3, pp. 274–283. Abstract, *Proc. Inst. Radio Engrs*, Aug. 1960, Vol. 48, No. 8, p. 1515.)

621.375.9: 621.372.44: 621.372.2 **477**

Shock Waves in Nonlinear Transmission Lines and their Effect on Parametric Amplification.—R. Landauer. (*IBM J. Res. Developm.*, Oct. 1960, Vol. 4, No. 4, pp. 391–401.) The propagation of a periodic signal on a transmission line with a nonlinearity in the distributed capacitance is examined. The signal is deformed during its propagation and e.m. shock waves are generated. The subsequent growth and decay of the shock are analysed. See also 2275 of 1960.

621.375.9: 621.372.44: 621.372.2 **478**

A Wide-Band U.H.F. Travelling-Wave Variable-Reactance Amplifier.—R. C. Honey & E. M. T. Jones. (*Trans. Inst. Radio Engrs*, May 1960, Vol. MTT-8, No. 3, pp. 351–361. Abstract, *Proc. Inst. Radio Engrs*, Aug. 1960, Vol. 48, No. 8, p. 1516.)

621.375.9: 621.372.44: 621.385.6 **479**

Low-Noise Electron-Beam Amplifier.—Labus. (See 744.)

621.375.9: 621.372.44: 621.385.6 **480**

New Microwave Tube Devices 'Fawshmotron' using the Fast Electron Waves.—Matsuo. (See 745.)

621.375.9: 621.382.23 **481**

Negative-Resistance Amplifier Design.—Schultz & Yin. (See 725.)

621.375.921.2 **482**

Negative-Resistance Distributed Amplifier.—C. A. Skalski. (*Proc. Inst. Radio Engrs*, Nov. 1960, Vol. 48, No. 11, pp. 1909–1910.) Operation of the amplifier is described in terms of iterative sections.

621.376.22 **483**

The Properties and Design of Ring Modulators.—H. Bley. (*Nachrichtentech. Z.*, March & April 1960, Vol. 13, Nos. 3 & 4, pp. 129–136 & 196–201.) Treatment, on the basis of quasilinear quadripole theory, of experimentally determined characteristics and design parameters of ring modulators.

621.376.22: 621.396.933.23 **484**

Mechanical Modulator uses Variable Capacitance.—Habra. (See 577.)

621.376.22.029.65: 621.382 **485**

The *p-i-n* Modulator, an Electrically Controlled Attenuator for mm and Sub-mm Waves.—F. C. de Ronde, H. J. G. Meyer & O. W. Memelink. (*Trans. Inst. Radio Engrs*, May 1960, Vol. MTT-8, No. 3, pp. 325–327. Abstract, *Proc. Inst. Radio Engrs*, Aug. 1960, Vol. 48, No. 8, p. 1515.)

621.376.3 **486**

Explicit Form of F.M. Distortion Products with White-Noise Modulation.—R. G. Medhurst & J. H. Roberts. (*Proc. Instn elect. Engrs*, Part C, Sept. 1960, Vol. 107, No. 12, pp. 367–369.) An extension and correction to 2281 of 1960 (Medhurst).

GENERAL PHYSICS

530.112: 530.12 **487**

First-Order Terrestrial Ether-Drift Experiment using the Mössbauer

Radiation.—M. Ruderfer. (*Phys. Rev. Lett.*, 1st Sept. 1960, Vol. 5, No. 5, pp. 191–192.) A one-way test of the special relativity and contraction theories is proposed, which would obviate the cancellation of first-order terms observed in two-way tests.

537.2 : 621.396.677.85 **488**

Electric Polarizability of a Short Right Circular Conducting Cylinder.—T. T. Taylor. (*J. Res. nat. Bur. Stand.*, July–Sept. 1960, Vol. 64B, No. 3, pp. 135–149.) Calculations to an accuracy of approximately five significant figures are carried out for cylinders with radius/half-length ratios of $\frac{1}{4}$, $\frac{1}{2}$, 1, 2 and 4. The results are applicable to the design of artificial dielectrics.

537.213 : 621.385.833 **489**

Method of Solving a Class of Axially Symmetric Problems in the Theory of Potential and Application to the Design of Electron-Optical Lenses.—G. A. Grinberg & I. A. Shukeilo. (*Zh. tekh. Fiz.*, Nov. 1959, Vol. 29, No. 11, pp. 1293–1303.) A class of problems arising in the calculation of e.s. fields with rotational symmetry is considered. If the systems satisfy certain conditions they can be treated by a method of successive approximations which are obtained by solving a plane e.s. problem.

537.311.33 **490**

A Note on the Theory of Space-Charge-Limited Currents.—C. Rhys-Roberts & R. H. Tredgold. (*Proc. phys. Soc.*, 1st Oct. 1960, Vol. 76, No. 490, pp. 497–501.) The experimental results of Branwood & Tredgold (219 of January) with $BaTiO_3$ are explained by a simple model in which there are thin layers of uncharged traps at the surface of the dielectric, which are uniformly distributed in space and of one energy depth; the bulk of the material contains no traps.

537.525 **491**

The Role of Cold Electron Emission due to Field Effect in the Maintenance at the Cathode of an Electric Discharge in a Highly Rarified Gas.—H. Doucet. (*C. R. Acad. Sci., Paris*, 8th Feb. 1960, Vol. 250, No. 6, pp. 1007–1009.) The hypothesis of electron emission at the cathode under the influence of the space charge due to positive ions is proposed and supported by preliminary experimental results.

537.525 : 538.56 **492**

Oscillation caused by Electron Sheath Breakdown.—S. Ohara & K. Takayama. (*Rev. elect. Commun. Lab., Japan*, Jan./Feb. 1960, Vol. 8, Nos. 1/2, pp. 7–11.) Relaxation oscillations of frequency 50–3 000 c/s were investigated by inserting a highly charged probe into the dark plasma of a hot-cathode gas-discharge tube.

537.56 **493**

Electron Energy Distributions in Plasmas: Part 2—Hydrogen.—R. L. F. Boyd & N. D. Twiddy. (*Proc. roy. Soc. A*, 6th Dec. 1960, Vol. 259, No. 1297, pp. 145–158.) The method given in Part 1 (3260 of 1959) is applied to the study of the mechanism of striation structure in hydrogen discharges.

537.56 : 538.614 **494**

Rotary Magnetic Polarization in Plasmas. Application to the Measurement of Electron Density.—T. Consoli & M. Dagni. (*C. R. Acad. Sci., Paris*, 8th Feb. 1960, Vol. 250, No. 6, pp. 1010–1012.)

537.56 : 538.614 **495**

Measurement of the Electron Density of a Plasma in Evolution. Experimental Apparatus.—T. Consoli & M. Dagni. (*C. R. Acad. Sci., Paris*, 15th Feb. 1960, Vol. 250, No. 7, pp. 1223–1225.) A general description of apparatus for measuring electron density in the range 10^{16}–10^{20} electrons/m^3.

537.56 : 538.63 **496**

Investigation of a Plasma Column Continuously Fed and Subjected to an Electromagnetic Field: Conditions for the Existence of Non-centred Maxwellian Solutions: Equations of Density.—J. M. Dolique. (*C. R. Acad. Sci., Paris*, 15th Feb. 1960, Vol. 250, No. 7, pp. 1221–1222.)

537.583 : 537.213 **497**

Potential Distribution between Two Plane Emitting Electrodes: Part 2—Thermionic Engines.—P. A. Lindsay & F. W. Parker. (*J. Electronics Control*, Aug. 1960, Vol. 9, No. 2, pp. 81–111.) All potential distributions can be represented by a two-parameter family of curves, the parameters depending on the electrode temperatures, potentials and work functions; the computed results show clearly the relative influence of these quantities on the potential minimum between the electrodes. Part 1: 2306 of 1960.

538.114 **498**

Equivalence of the Critical Concentrations in the Ising and Heisenberg Models of Ferromagnetism.—R. J. Elliott, B. R. Heap, D. J. Morgan & G. S. Rushbrooke. (*Phys. Rev. Lett.*, 15th Oct. 1960, Vol. 5, No. 8, pp. 366–367.)

538.221 : 621.318.134 : 538.569.4 **499**

Ferrimagnetic Resonance in Three-Sublattice Systems.—R. K. Wangness. (*Phys. Rev.*, 1st Sept. 1960, Vol. 119, No. 5, pp. 1496–1500.)

538.56 : 621.372.413 **500**

Sets of Eigenvectors for Volumes of Revolution.—J. Van Bladel. (*Trans. Inst. Radio Engrs*, May 1960, Vol. MTT-8, No. 3, pp. 309–319. Abstract, *Proc. Inst. Radio Engrs*, Aug. 1960, Vol. 48, No. 8, p. 1515.)

538.561 : 537.122 **501**

On the Cherenkov Effect for a Charge Moving above an Interface.—A. G. Sitenko & V. S. Tkalich. (*Zh. tekh. Fiz.*, Sept. 1959, Vol. 29, No. 9, pp. 1074–1085.) Mathematical analysis relating to the e.m. radiation due to the movement of a charged particle and a modulated beam of charged particles in the proximity of a dielectric.

538.561 : 537.122 **502**

On the Cherenkov Radiation of Dipole Moments Moving along an Axial Channel in a Dielectric.—L. S. Bogdankevich. (*Zh. tekh. Fiz.*, Sept. 1959, Vol. 29, No. 9, pp. 1086–1089.) The radiation field is calculated for a magnetic and electric dipole moving in a dielectric. If the radius of the channel $a \ll \lambda$ then the radiation of the electric dipole moving perpendicularly to the axis increases by a factor of $4\epsilon^2/(\epsilon + 1)^2$ compared with the radiation in the dense medium of the dielectric.

538.566 : 535.42] + 534.26 **503**

Diffraction of a Pulse by a Resistive Half-Plane.—V. M. Papadopoulos. (*Proc. roy. Soc. A*, 10th May 1960, Vol. 255, No. 1283, pp. 538–557.) The two-dimensional diffraction problem, acoustic or e.m., in which the incident pulse front is parallel to the edge of a half-plane, is solved by assuming dynamic similarity in the solution. Relations between this problem and the three-dimensional problem which arises when a plane pulse is incident obliquely at the edge of a resistive half-plane are discussed.

538.566 : 535.42 **504**

The Diffraction of Electromagnetic Waves.—R. King. (*Z. angew. Phys.*, Feb. 1960, Vol. 12, No. 2, pp. 88–95.) Mathematical treatment of diffraction and scattering at the surface of a conducting circular cylinder.

538.566 : 535.42 **505**

Diffraction of Electromagnetic Waves at a Paraboloidal Screen of Finite Dimensions (Axially-Symmetric Fields).—Yu. N. Kuz'min. (*Zh. tekh. Fiz.*, Nov. 1959, Vol. 29, No. 11, pp. 1304–1311.) Theoretical treatment of diffraction at a thin ideally conducting paraboloidal segment.

538.566 : 535.42 **506**

Diffraction by an Imperfectly Conducting Half-Plane at Oblique Incidence.—T. B. A. Senior. (*Appl. sci. Res.*, 1959, Vol. B8, No. 1, pp. 35–61.) The exact solution has been obtained for the problem of a plane wave incident at an oblique angle on a metallic half-plane. The analysis requires the solution of coupled Wiener-Hopf integral equations for the electric and magnetic current distributions excited on the surface of the half-plane.

538.566 : 535.42 **507**

Diffraction of an Electromagnetic Plane Wave by a Metallic Sheet.—W. E. Williams. (*Proc. roy. Soc. A*, 20th Sept. 1960, Vol. 257, No. 1290, pp. 413–419.) A new generalized technique is developed for the solution of the problem of the diffraction of an E-polarized plane wave incident at an oblique angle on an imperfectly conducting half-plane. The solution obtained shows complete agreement with that of Senior (506 above).

538.566 : 535.42 **508**

Aperture Fields in the Diffraction by a Slit.—H. P. Hsu. (*J. appl. Phys.*, Oct. 1960, Vol. 31, No. 10, pp. 1742–1746.) A description of measurements at 3·2 cm λ, using a parallel-plate device, of the field distribution over apertures of width 1·27, 2·21, 3 and 3·5 λ.

538.566 : 535.42 : 621.396.677 **509**

The Various Statements of Kirchhoff's Principle and their Application to the

Diffraction Diagrams of Electromagnetic Waves.—G. F. Koch. (*Arch. elekt. Übertragung*, Feb. & March 1960, Vol. 14, Nos. 2 & 3, pp. 77–90 & 132–153.) The various approximation methods based on Kirchhoff's principle are applied to the case of microwave diffraction at a diaphragm and a reflector disk, particularly for oblique incidence. Comparisons are made with experimental results. Reflection at mirrors with dimensions of the order of a few wavelengths is considered with regard to the calculation of surface emission and reflection cross-sections. 53 references.

538.566: 535.43 **510**

Transmission Coefficient for a System of Parallel Slits in a Thin, Plane Screen.—K. Saermark. (*Appl. sci. Res.*, 1959, Vol. B8, No. 1, pp. 29–34.) An extension of earlier work on the scattering of e.m. waves (*Appl. sci. Res.*, 1959, Vol. B7, No. 6, pp. 417–440) to include more than two parallel slits in a perfectly conducting screen.

538.566: 537.56 **511**

Dielectric Constant of a Dense Electron Gas.—T. Pradhan & P. Misra. (*Phys. Rev.*, 15th Sept. 1960, Vol. 119, No. 6, pp. 1878–1881.) Theoretical investigation of dispersion and absorption of e.m. waves in a dense electron gas.

538.566: 537.56 **512**

Propagation Constants for Electromagnetic Waves in Weakly Ionized, Dry Air.—A. V. Phelps. (*J. appl. Phys.*, Oct. 1960, Vol. 31, No. 10, pp. 1723–1729.) Data are given for dry air at ionospheric temperatures in the presence of a magnetic field. The magnitude and energy dependence of the electron collision frequency are also derived.

538.566: 621.396.67 **513**

Electromagnetic Fields of Axial Symmetry Bounded by a Cone and a Sphere.—H. Buchholz. (*Arch. Elektrotech.*, 17th Feb. 1960, Vol. 45, No. 1, pp. 27–48.) The radiation field of a floating magnetic current ring in a space enclosed by spheres and cones is calculated. This solution is extended to certain limiting conditions of direct bearing on e.m. radiation from aerials in free space.

538.567: [621.372.8 + 621.385.6 **514**

Some Properties of Three Coupled Waves.—L. Solymar. (*Trans. Inst. Radio Engrs*, May 1960, Vol. MTT-8, No. 3, pp. 284–291. Abstract, *Proc. Inst. Radio Engrs*, Aug. 1960, Vol. 48, No. 8, p. 1515.)

538.569: 539.2 **515**

Induced and Spontaneous Emission in a Coherent Field: Part 3.—I. R. Senitzky. (*Phys. Rev.*, 15th Sept. 1960, Vol. 119, No. 6, pp. 1807–1815.) Theory, developed in Parts 1 & 2 (3777 of 1958 & 862 of 1960), dealing with the interaction between the e.m. field in a cavity resonator and a number of two-level molecules, is generalized to include a Gaussian spread in the molecular frequency.

538.569.4 **516**

Microwave Emission from an Optically Pumped Atomic System.—V. E. Derr, J. J. Gallagher, R. E. Johnson & A. P. Sheppard. (*Phys. Rev. Lett.*, 1st Oct. 1960, Vol. 5, No. 7, pp. 316–318.) Preliminary results are reported of an experiment in which the microwave emission at about 9 192 Mc/s from an optically pumped Cs cell has been directly detected.

538.569.4: 535.853 **517**

Recording R.F. Spectrometer for Nuclear Quadrupole Zeeman Spectra.—C. Dean. (*Rev. sci. Instrum.*, Sept. 1960, Vol. 31, No. 9, pp. 934–941.) Circuit details are given of semiautomatic apparatus in continuous operation for recording chlorine resonances in the 30–40-Mc/s region.

538.569.4: 535.853 **518**

A Simple Spectrograph for Nuclear Paramagnetic Resonance.—R. Becherer. (*C. R. Acad. Sci., Paris*, 8th Feb. 1960, Vol. 250, No. 6, pp. 1037–1039.) Description of modifications to the Bloch spectrograph which simplify decoupling problems.

538.569.4: 535.853: 621.375.9 **519**

Sensitivity of Microwave Spectrometers using Maser Techniques.—C. H. Townes. (*Phys. Rev. Lett.*, 1st Nov. 1960, Vol. 5, No. 9, pp. 428–430.) Expressions are derived for the reduction in the coefficient of minimum detectable absorption in a microwave waveguide when molecules in an excited state are added along the waveguide. The application of this principle to a cavity spectrometer is discussed.

538.569.4: 621.375.9 **520**

Atomic Hydrogen Maser.—Goldenberg, Kleppner & Ramsey. (See 474.)

GEOPHYSICAL AND EXTRATERRESTRIAL PHENOMENA

523.16: 551.507.362.1 **521**

An Instrument for the Investigation of Interplanetary Plasma.—H. S. Bridge, C. Dilworth, B. Rossi & F. Scherb. (*J. geophys. Res.*, Oct. 1960, Vol. 65, No. 10, pp. 3053–3055.) A Faraday cup is described, for use on a deep probe, to measure the density and the magnitude and direction of the bulk velocity of the positive ions.

523.164.3 **522**

Amplitude Scintillation of Radio Star at Ultra High Frequency.—H. C. Ko. (*Proc. Inst. Radio Engrs*, Nov. 1960, Vol. 48, No. 11, pp. 1871–1880.) Observations of Cygnus-A at 915 Mc/s over a 12-month period are described and show short-term and seasonal fluctuations of scintillation rate as well as some correlation with geomagnetic effects.

523.164.3 **523**

Evidence for the Solar Corpuscular Origin of the Decametre-Wavelength Radiation from Jupiter.—T. D. Carr, A. G. Smith & H. Bollinger. (*Phys. Rev. Lett.*, 1st Nov. 1960, Vol. 5, No. 9, pp. 410–411.) Some correlation was found between 10-Mc/s and 18-Mc/s emissions from Jupiter between April and August 1960, and the occurrence of geomagnetic disturbance about nine days earlier. Some events were associated with solar flares.

523.164.3 **524**

New Limits to the Diameters of some Radio Sources.—L. R. Allen, H. P. Palmer & B. Rowson. (*Nature, Lond.*, 26th Nov. 1960, Vol. 188, No. 4752, pp. 731–732.) Observations using a base line of 32 000 λ have shown that at least seven sources have major features smaller than three seconds of arc, with extremely high surface brightness.

523.164.32 **525**

Relation between the Position and the Sense of Polarization of Solar Radio Storms.—A. M. Malinge. (*C. R. Acad. Sci., Paris*, 15th Feb. 1960, Vol. 250, No. 7, pp. 1186–1188.) Observations of the positions of solar storm centres made with the great interferometer at Nançay at 169 Mc/s have been related to measurements of polarization made at Néra, Netherlands, at 200 Mc/s. Results show that the radiation from storm centres in the northern solar hemisphere has a predominantly right-hand polarization and that from the southern, left-hand polarization.

523.164.32: 523.75 **526**

Solar Bursts of Type III and their Relation to Flares.—H. H. Rabben. (*Z. Astrophys.*, 26th Jan. 1960, Vol. 49, No. 2, pp. 95–110.) Recordings of bursts made by radiometer and radio spectrograph at Freiburg and other observatories are analysed, and their relation to flares observed in the same period is studied.

523.165 **527**

The Radiation Belt produced by Neutrons Leaking out of the Atmosphere of the Earth.—W. N. Hess. (*J. geophys. Res.*, Oct. 1960, Vol. 65, No. 10, pp. 3107–3115.) The composition of the radiation belts is compared with that expected for a neutron decay source. It seems that the inner belt is produced only by neutron decay. In the outer belt the electrons of energy greater than 200 keV are probably produced by neutron decay but those of lower energy probably come from outside the belt.

523.165 **528**

The Solar Daily Variation of the Cosmic Radiation: World-Wide Neutron Monitor Observations during the International Geophysical Year.—G. Schwachheim. (*J. geophys. Res.*, Oct. 1960, Vol. 65, No. 10, pp. 3149–3157.)

523.165 **529**

Effects of Short-Term World-Wide Modulation of the Primary Cosmic Radiation on Observed Daily Intensity Variations.—N. R. Parsons. (*J. geophys. Res.*, Oct. 1960, Vol. 65, No. 10, pp. 3159–3163.)

523.165 **530**

Observations of the Van Allen Radiation Regions during August and September 1959: Part 1.—A. J. Dessler.

(*J. geophys. Res.*, Oct. 1960, Vol. 65, No. 10, pp. 3487–3496.) Discussion of 3478 of 1960 (Arnoldy et al.).

523.165 **551**

Latitude and Altitude Distribution of Geomagnetically Trapped Protons.—S. F. Singer. (*Phys. Rev. Lett.*, 1st Oct. 1960, Vol. 5, No. 7, pp. 300–303.) A theory is derived for a geometrical injection coefficient of trapped protons of cosmic-ray origin. Calculated distributions resemble contours obtained experimentally.

523.165 **552**

Diffusion of Particles in the Earth's Radiation Belts.—S. Herlofson. (*Phys. Rev. Lett.*, 1st Nov. 1960, Vol. 5, No. 9, pp. 418–419.) Fluctuations in the geomagnetic field may cause diffusion of particles across the field. The distribution of particles predicted by a theoretical study of diffusion is compared with observations using Sputnik IV.

523.165: 550.385.4 **553**

Geomagnetic Fluctuations and the Form of the Outer Zone of the Van Allen Radiation Belt.—E. N. Parker. (*J. geophys. Res.*, Oct. 1960, Vol. 65, No. 10, pp. 3117–3130.) The sudden compression of the geomagnetic field, associated with the initial phase of a magnetic storm, causes electrons to diffuse radially across the geomagnetic field. It is estimated that a particle at $r = 3{\cdot}5\ R_E$ will diffuse a distance R_E in about 5 years.

523.165: 550.385.4 **554**

Charged-Particle Variations in the Outer Van Allen Zone during a Geomagnetic Storm.—T. A. Farley & A. Rosen. (*J. geophys. Res.*, Oct. 1960, Vol. 65, No. 10, pp. 3494–3496.) Fluctuations in the particle fluxes and local magnetic field were observed by Explorer VI at 44 000 km during the geomagnetic storm of 16th August 1959 and found to be correlated. The numbers of low-energy particles decreased and high-energy particles increased. The results are consistent with the theories of Dessler & Parker (1586 of 1960).

523.165: 551.507.362.2 **535**

A Study of Variations of Corpuscular Radiation Observed by Satellite 1958 Epsilon near Japan.—M. Hirono & H. Akima. (*Rep. Ionos. Space Res. Japan*, March 1960, Vol. 14, No. 1, pp. 41–68.) Observations in August and September 1958 are related to the electron shell of the Argus I explosion. The lowering of mirror points by Coulomb scattering and the influence of corpuscular radiation on the ionosphere are examined.

523.3: 621.396.96 **536**

Radar Methods of Measuring the Cislunar Electron Density.—V. R. Eshleman, P. B. Gallagher & R. C. Barthle. (*J. geophys. Res.*, Oct. 1960, Vol. 65, No. 10, pp. 3079–3086.) Six related techniques for measuring the integrated electron density between the earth and the moon are discussed. These are based on the determination of the group retardation suffered by low-frequency radar echoes. Very high peak power (pulse technique) or very high equipment stability (c.w. technique) would be required to measure absolute radar range but this difficulty can be avoided by sending a reference signal with the measuring signal. The effects of path splitting, electron 'blobs' and lunar surface irregularities are considered.

523.3: 621.396.96 **537**

A Lunar and Planetary Echo Theory.—W. E. Brown, Jr. (*J. geophys. Res.*, Oct. 1960, Vol. 65, No. 10, pp. 3087–3091.) A lunar radio echo is divided into a specular component and a Lambert scatter component based on a model of the lunar surface. The theory is compared with experimental data on the shape and frequency spectrum of reflected pulses.

523.75: 550.385.4 **538**

Propagation of Solar Cosmic Rays through Interplanetary Magnetic Fields.—T. Obayashi & Y. Hakura. (*J. geophys. Res.*, Oct. 1960, Vol. 65, No. 10, pp. 3143–3146.) Type III polar blackouts are closely associated with solar flares which are accompanied by type IV noise outbursts. The delay before the commencement of the type III blackout is about 10 hours for flares in the east sector of the sun and about 4 hours for flares in the west. The difference is ascribed to a regular distortion of the outer solar magnetic field. The commencement of the geomagnetic storm is not dependent on the solar longitude of the flare.

550.38: 523.16 **539**

The Gross Character of the Geomagnetic Field in the Solar Wind.—P. A. Johnson. (*J. geophys. Res.*, Oct. 1960, Vol. 65, No. 10, pp. 3049–3051.) The field may be deformed into a tear-drop shape by the interplanetary plasma. It is emphasized that the asymmetry of the deformed field ought to be considered in space investigations.

550.382: 621.391.812.63 **540**

Note on the Geometry of the Earth Magnetic Field useful to Faraday-Effect Experiments.—K. C. Yeh & V. H. Gonzalez. (*J. geophys. Res.*, Oct. 1960, Vol. 65, No. 10, pp. 3209–3214.) A study of the factor $H \cos \phi \sec i$ where ϕ and i are the angles between a ray and, respectively, the earth's field and the vertical.

550.385: 551.594.2 **541**

Audio-Frequency Fluctuations in the Geomagnetic Field.—J. B. Wilcox & E. Maple. (*J. geophys. Res.*, Oct. 1960, Vol. 65, No. 10, pp. 3261–3271.) An examination of recordings at three locations widely spaced in latitude indicates that equatorial thunderstorms are the major sources of fluctuations in the frequency range 40–16 000 c/s.

550.386(99) **542**

Geomagnetic Observations at Halley Bay.—J. MacDowall. (*Proc. roy. Soc. A*, 21st June 1960, Vol. 256, No. 1285, pp. 219–221.)

551.507.362 **543**

Results of Scientific Investigations made by Soviet Sputniks and Cosmic Rockets.—V. I. Krassovsky (Krasovskiĭ). (*Astronautica Acta*, 1960, Vol. 6, No. 1, pp. 32–47.) Report presented at a meeting of the American Rocket Society, Washington, D.C., November 1958.

551.507.362: 523.3 **548**

Payload Design for a Lunar Satellite.—P. J. Glaser & E. R. Spangler. (*Electronics*, 28th Oct. 1960, Vol. 33, No. 44, pp. 63–67.) A description of the experiments planned and the equipment and methods used in the Able-1 rehearsal.

551.507.362.1 **545**

On Geomagnetic Observations with the Aid of the Two Outer Lunar Radii.—M. G. Arnoldov & A. D. Shevnin. (*Dokl. Akad. Nauk S.S.S.R.*, 11th Nov. 1960, Vol. 135, No. 1, pp. 296–300.) The results of the investigation show that the rate at which the intensity of the magnetic field decreases with height is greater than the calculated one. A graph indicates the variation for heights between 11 000 km and 30 000 km.

551.507.362.2 **546**

Circulating Elements Derived from the Modified Hansen Theory for the Motion of an Artificial Satellite.—A. Ballif & R. Bryant. (*Astr. J.*, Oct. 1960, Vol. 65, No. 8, pp. 453–455.) Musen's development of the Hansen theory for the motion of an artificial satellite can also lead to an expression for the velocity vector and osculating elements, as well as for the gravitational perturbations.

551.507.362.2 **547**

An Algorithm Applicable to Numerical Integration of Orbits in Multi-revolution Steps.—C. J. Cohen & E. C. Hubbard. (*Astr. J.*, Oct. 1960, Vol. 65, No. 8, pp. 458–459.)

551.507.362.2 **548**

Variations in the Orbit of the Echo Satellite.—R. Jastrow & R. Bryant. (*J. geophys. Res.*, Oct. 1960, Vol. 65, No. 10, pp. 3342–3343.) Minitrack observations of the Echo satellite show that, owing to the sun's radiation pressure, the perigee distance and eccentricity of the orbit are varying at rates which are in good agreement with the theoretical rates. The observations also lead to a value for atmospheric density at a height of 1 500 km.

551.507.362.2: 621.391.812.6 **549**

Evidence of Satellite-Induced Ionization Effects between Hemispheres.—J. D. Kraus. (*Proc. Inst. Radio Engrs*, Nov. 1960, Vol. 48, No. 11, pp. 1913–1914.) Signal enhancement over a 330-mile path is correlated with reflection from ionization caused by Sputnik III. This occurred both when the satellite was in the northern and the southern auroral zones and an explanation for this is advanced.

551.510.535 **550**

Some Studies of Bifurcation of the Ionospheric F Layer into F_1 and F_2.—C. S. G. K. Setty. (*J. atmos. terr. Phys.*, Oct. 1960, Vol. 19, No. 2, pp. 82–87.) Ionograms recorded at frequent intervals at Cambridge in 1954 and 1955 show how the F layers develop at sunrise, on quiet and disturbed days and at different seasons.

Impulsive Disturbances following a Solar Flare.—G. E. Hill. (*J. geophys. Res.*, Oct. 1960, Vol. 65, No. 10, pp. 3183–3207.) The perturbations of f_{min}, f_0E_2 and f_0F_2 following the great flare of 11th September 1957 are shown on polar projection maps. The f_{min} charts differ significantly from those of Obayashi & Hakura (2376 of 1960) for the same period. The f_{min} disturbance during the geomagnetic storm forms an elliptic ring with the E_2 concentrated in crescent-shaped areas inside it. The results are discussed theoretically.

551.510.535: 523.78 **556**

Back-Scatter Experiments during the Total Eclipse of October 2, 1959.—C. Malik, J. Aarons & H. Poeverlein. (*J. geophys. Res.*, Oct. 1960, Vol. 65, No. 10, pp. 3241–3247.) The eclipse perturbations could not be clearly separated from those due to other disturbances.

551.510.535: 523.78 **557**

Eclipse Effects on the F Layer at Sunrise.—C. S. G. K. Setty. (*J. atmos. terr. Phys.*, Oct. 1960, Vol. 19, No. 2, pp. 73–81.) An analysis of electron-density variations during the solar eclipse of September 1951, which took place near sunrise in Maryland, U.S.A. (about 06°), of the morning radiowave data have originated outside the solar disk.

551.510.535: 523.78 **558**

Eclipse Effects on the E Layer Observed at Cambridge on 6th June 1954.—C. S. G. K. Setty. (*J. atmos. terr. Phys.*, Oct. 1960, Vol. 19, No. 2, pp. 95–101.) Variations of f_0E, during the solar eclipse of June 1954 are discussed. About 10% of the morning radiowave data have originated outside the solar disk.

551.510.535: 550.385.37 **559**

A Comparison between F_1 and the E Region.—M. J. Dudley. (*Nature, Lond.*, 26th Nov. 1960, Vol. 188, No. 4753, pp. 769–770.) The diurnal variation of ionospheric absorption at the F_1 type near the equator is currently related to the diurnal variation of the two thermal layers — E and F_1. The temperature of the ionosphere, as a source of F_1 oscillations, is also discussed.

551.510.535: 551.507.362.2 **560**

Determination of Electron Density in the Ionosphere from the Rotation of the Plane of Polarization of Radio Waves Emitted by a Rocket.—N. I. Tyrnogen & V. A. Rudakov. (*Dokl. Akad. Nauk SSSR*, 21st June 1960, Vol. 132, No. 6, pp. 1311–1314.) Rocket investigations on the 27th August 1958 at heights up to 450 km, at frequencies of 20, 40 and 100 Mc/s are reported. A graph shows the variation of electron density with altitude.

551.510.535: 621.3.087.4 **561**

Reducing Interference in Ionospheric Sounding.—K. Bury. (*Electronics*, 27th Oct. 1960, Vol. 33, No. 35, pp. 110–120.) A special circuit is described for separating the desired pulses from interfering echo signals.

551.510.535(99) : 523.75 **562**

Solar Corpuscular Radiation and Polar Ionospheric Disturbances.—F. Obayashi & Y. Hakura. (*J. geophys. Res.*, Oct. 1960, Vol. 65, No. 10, pp. 3133–3142.) Typical examples of abnormal absorption at high latitudes are described and compared for (*a*) low-energy cosmic-ray events, (*b*) geomagnetic storms, and (*c*) combined cosmic-ray events and storms. The energy spectra of the solar particles involved are discussed and summarized.

551.510.535 (99) **563**

The Ionosphere over Halley Bay.—W. H. Bellchambers & W. R. Piggott. (*Proc. roy. Soc. A*, 21st June 1960, Vol. 256, No. 1285, pp. 200–218. Discussion.) "The ionospheric phenomena observed at Halley Bay are briefly described and the influence of the Weddell Sea magnetic dip anomaly stressed. Some ionization is generated in the lower ionosphere by solar photo-ionization processes at solar zenith angles up to about 100°. The F_2-layer variations appear to be dominated by movements of ionization which can also be seen near the maximum of the F_1 layer. Ionization drift velocities in the E region reverse with season and are greater in winter than in summer. Other features of drift and absorption are generally consistent with those expected."

551.510.535(99) : 523.164 **564**

Ionospheric Drifts determined from Radio-Star Scintillation Observations.—F. W. Brown. (*Proc. roy. Soc. A*, 21st June 1960, Vol. 256, No. 1285, pp. 220–234.) Spaced-receiver observations have been made at Halley Bay and ionospheric velocities deduced from the motion of the diffraction pattern over the ground. Both the time of midnight reversal and the peak speed correlate well with Kyoto magnetic data of intensity of auroral forms (see 648 below).

551.594.5 **565**

Optical Patterns in Geophysics.—C. Age. (*J. atmos. terr. Phys.*, Oct. 1960, Vol. 19, No. 2, pp. 130–146.) The spiral patterns found in cosmic analysis of magnetic and ionospheric data are investigated with Newton's theory.

551.594.5 **566**

Latitude Classification and Seasonal Variation of Auroral-zone Air Glow from Byrd Station during 1957 and 1958.—H. McDonald & K. A. Robertson. (*J. atmos. terr. Phys.*, Oct. 1960, Vol. 19, No. 2, pp. 155–165.)

551.594.5: 621.396.96 **567**

On the Origin of Radio Echoes associated with Auroral Activity.—J. Olsen & S. Olving. (*Nature, Lond.*, 26th Nov. 1960, Vol. 188, No. 4753, pp. 757–758.) Observations at Kiruna, Sweden, at 30 Mc/s indicate that the predominant echo mechanism is closely connected with ionized and often invisible auroral forms which are directed along the geomagnetic field.

551.594.5.550 **568**

Ionospheric Observations at Invercargill, New Zealand.—K. Evans. (*Proc. roy. Soc. A*, 21st June 1960, Vol. 256, No. 1285, pp. 236–248.) All-sky photographs have been used to determine the movement of individual auroral features, on the assumption of a fixed height of occurrence. See also 110 of 1960.

551.594.5(99) **569**

Auroral Results from Halley Bay during the International Geophysical Year.—G. M. Thomas. (*Proc. roy. Soc. A*, 21st June 1960, Vol. 256, No. 1285, pp. 241–244. Discussion.)

551.594.5(99) : 621.396.96 **570**

Auroral Radio Echoes at Halley Bay.—D. P. Harrison. (*Proc. roy. Soc. A*, 21st June 1960, Vol. 256, No. 1285, pp. 229–234.) The echoes observed are shown to fit closely the case of specular reflection from columns of ionization aligned along the local magnetic field at a height of about 100 km.

551.594.6 **571**

The Effect of Proton Gyration in the Outer Atmosphere represented on the Dispersion Curve of Whistler.—T. Ondoh & S. Hashizume. (*J. Geomag. Geoelect.*, 1960, Vol. 12, No. 1, pp. 32–37.) Whistlers observed at Kyoto, geomagnetic latitude 24·7°N, reach a height of 1 350 km. The dispersion of a very pure whistler at Kyoto in 1958 was measured from 10 kc/s to less than 1 kc/s and compared with that calculated using the complete dispersion law. It

is concluded that the dispersion was influenced by the effect of proton gyration.

551.594.6 **572**

Propagation of Whistlers to Polar Latitudes.—G. McK. Allcock. (*Nature, Lond.*, 26th Nov. 1960, Vol. 188, No. 4752, pp. 732–733.) An analysis of observations made in New Zealand, North America and Antarctica of the dispersion characteristics of a whistler associated with a depression which occurred in the area of the Tasman Sea at 0836 U.T. on 7th April 1959. Reception to this whistler in the Antarctic would imply a final stage of propagation under the ionosphere for more than 2 800 km.

551.594.6: 621.391.82 **573**

Observations of Earth-Ionosphere Cavity Resonances.—Balser & Wagner. (See 688.)

LOCATION AND AIDS TO NAVIGATION

534.88: 621.396.962.25/.3 **574**

An Experimental Comparison between a Pulse and a Frequency-Modulation Echo-Ranging System.—L. Kay. (*J. Brit. Instn Radio Engrs*, Oct. 1960, Vol. 20, No. 10, pp. 785–796.) A wide-band pulse system provides higher range resolution than the f.m. system, which in turn is superior to a pulse system of limited bandwidth. See also 1893 of 1959.

621.396.663 **575**

The Wave Analyser: Equipment for the Simultaneous Direction-Finding of Several Incident Wave Trains.—K. Baur. (*Frequenz*, Feb. 1960, Vol. 14, No. 2, pp. 41–46.) To overcome problems arising from multipath propagation a system of analysing the interference pattern at the aerial array is proposed which makes use of computer circuitry. Examples are discussed of single-, two- and three-wave direction finders.

621.396.932.2 **576**

A Microwave Position-Fixing System.—H. R. Smyth. (*J. Inst. Nav.*, April 1960, Vol. 13, No. 2, pp. 164–172.) A narrow-beam rotating aerial on board ship operates in conjunction with shore-based beacon transmitters. The bearings of the beacons relative to north are displayed in digital form with a discrimination of 0·02°. Field tests on the system are described.

621.396.933.23: 621.376.22 **577**

Mechanical Modulator uses Variable Capacitance.—J. Habra. (*Electronics*, 28th Oct. 1960, Vol. 33, No. 44, pp. 68–69.) Description of a modulator for a landing guidance system using a mechanically rotated capacitor and a hybrid ring to give a constant characteristic impedance and modulation depth.

621.396.96: 629.13.052 **578**

Electrical Measurement of Altitude: Part 1—Physical Fundamentals.—H. J. Zetzmann. (*Arch. tech. Messen*, Feb. 1960, No. 289, pp. 21–24.) Operating principles of terrain-clearance and radar-type altimeters are outlined. 43 references.

621.396.962.2: 621.373.421.13 **579**

The Importance of Constant Frequencies for C. W. Radar Techniques and the Achievement of High Frequency Stability.—W. Herzog. (*Nachrichtentech. Z.*, Jan. 1960, Vol. 13, No. 1, pp. 29–33.) Circuit and performance data are given for highly stable crystal oscillators of simple construction.

621.396.962.3 **580**

Getting High Range Resolution with Pulse-Compression Radar.—G. P. Ohman. (*Electronics*, 7th Oct. 1960, Vol. 33, No. 41, pp. 53–57.) See also 2023 of 1960 (Cook).

MATERIALS AND SUBSIDIARY TECHNIQUES

535.215 **581**

Grain-Boundary Photoresponse.—W. W. Lindemann & R. K. Mueller. (*J. appl. Phys.*, Oct. 1960, Vol. 31, No. 10, pp. 1746–1751.) A discussion of measurements indicating the limitations to the sensitivity of grain-boundary photocapacitors, and of spectral response data showing absorption-edge irregularities.

535.215 **582**

Measurements on Multi-alkali Photocathodes.—G. Frischmuth-Hoffmann, P. Görlich, H. Hora, W. Heimann & H. Marseille. (*Z. Naturf.*, July 1960, Vol. 15a, No. 7, pp. 648–650.) A (Cs-Na-K)Sb cathode, similar to that studied by Spicer (825 of 1959), is investigated and the quantum yield determined. Comparisons are made with results of measurements on Cs_3Sb cathodes [3838 of 1958 (Görlich & Hora)].

535.215 **583**

Photoelectric Properties of Anodically Produced Titanium and Niobium Oxide Layers.—J. Rupprecht. (*Naturwissenschaften*, March 1960, Vol. 47, No. 6, pp. 127–128.)

535.215: 546.48'221 **584**

The Problem of Space-Charge-Limited Currents in CdS Crystals.—E. Schnürer. (*Z. Naturf.*, July 1960, Vol. 15a, No. 7, pp. 645–647.) Measurements of photocurrent/voltage characteristics were made on CdS cells with Au electrodes after γ-ray bombardment. The mechanism governing the changes in photocurrent is discussed on the basis of these results. See also 1622 of 1959 (Wright).

535.215: 546.48'221 **585**

An Improved Method of Growing CdS Crystals from the Vapour Phase.—P. D. Fochs. (*J. appl. Phys.*, Oct. 1960, Vol. 31, No. 10, pp. 1733–1734.)

535.215: 546.681'221'241 **586**

Photoconductivity in Gallium Sulphoselenide Solid Solutions.—R. H. Bube & E. L. Lind. (*Phys. Rev.*, 1st Sept. 1960, Vol. 119, No. 5, pp. 1535–1537.) The photoconductivity characteristics of solid solutions of GaSe and GaS have been investigated for proportions of GaS between 10 and 50%. The results indicate that the photocurrent is carried primarily by holes.

535.215: 546.817-31 **587**

On the Photoconductive Properties of Lead Monoxide.—M. Wada, T. Takahashi & T. Seki. (*Sci. Rep. Res. Inst. Tohoku Univ., Ser. B*, 1959, Vol. 11, No. 1, pp. 55–61.)

535.215: 548.0 **588**

Toroidal Energy Surfaces in Crystals with Wurtzite Symmetry.—R. C. Casella. (*Phys. Rev. Lett.*, 15th Oct. 1960, Vol. 5, No. 8, pp. 371–373.)

535.37: 546.48'221 **589**

Change in Structure of Blue and Green Fluorescence in Cadmium Sulphide at Low Temperatures.—L. S. Pedrotti & D. C. Reynolds. (*Phys. Rev.*, 15th Sept. 1960, Vol. 119, No. 6, pp. 1897–1898.)

535.376: 546.47'221 **590**

The Influence of the Excitation Wavelength of Electrophotoluminescence.—H. Gobrecht & H. E. Gumlich. (*Z. Phys.*, 18th Feb. 1960, Vol. 158, No. 2, pp. 226–241.) Investigation of the electrophotoluminescence of ZnS-Mn as a function of the wavelength of the ultraviolet light used for excitation. A model of the field enhancement and quenching of luminescence is derived which is in agreement with earlier results (3894 of 1960).

537.227 **591**

Ferroelectricity in Potassium Ferrocyanide Trihydrate and its Isomorphous Substances.—S. Waku, K. Masuno, T. Tanaka & H. Iwasaki. (*J. phys. Soc. Japan*, July 1960, Vol. 15, No. 7, pp. 1185–1189.)

537.227: 546.431'824-31 **592**

Measurements of the Dielectric Constant of $BaTiO_3$ Single Crystals in the Paraelectric Region at X Band.—A. Lurio & E. Stern. (*J. appl. Phys.*, Oct. 1960, Vol. 31, No. 10, pp. 1805–1809.)

537.228.1: 549.514.51 **593**

V.H.F. Crystal Polishing and the Nature of Polished Quartz Surfaces.—I. Ida & Y. Arai. (*Rev. elect. Commun. Lab., Japan*, March/April 1960, Vol. 8, Nos. 3/4, pp. 119–174.)

537.311.33 **594**

The Theory of Ion Motion in Semiconductors.—F. Ollendorff. (*Arch. Elektrotech.*, 17th Feb. 1960, Vol. 45, No. 1, pp. 10–26.) Phenomenological description of ion motion in a homogeneous isotropic semiconductor. The shortcomings of the theoretical results are discussed with the aid of a numerical example.

537.311.33 **595**

Note on the Field Dependence of the Mobility in Semiconductors.—M. Hattori & H. Sato. (*J. phys. Soc. Japan*, July 1960, Vol. 15, No. 7, pp. 1237–1242.) By assuming that the mobility μ can be expanded in powers of the field strength F as $\mu = \mu_0 (1 - \nu F^2)$, ν is calculated for nonpolar and

polar semiconductors, neglecting collisions between electrons. See also 1284 of 1960 (Sato).

537.311.33 **596**

Surface Space-Charge Calculations for Semiconductors.—D. R. Frankl. (*J. appl. Phys.*, Oct. 1960, Vol. 31, No. 10, pp. 1752–1754.) "Approximation formulas for the surface excesses of carriers at large values of the reduced surface and bulk potentials are derived, and computed results are presented."

537.311.33 **597**

Solubility of Flaws in Heavily Doped Semiconductors.—W. Shockley & J. L. Moll. (*Phys. Rev.*, 1st Sept. 1960, Vol. 119, No. 5, pp. 1480–1482.) A simple model is presented which shows how the solubility of a charged impurity in a semiconductor depends upon the Fermi level.

537.311.33 **598**

Cascade Capture of Electrons in Solids.—M. Lax. (*Phys. Rev.*, 1st Sept. 1960, Vol. 119, No. 5, pp. 1502–1523.) Giant trapping cross-sections associated with Coulomb attractive centres are explained in terms of a high rate of capture into highly excited states, followed by a cascade process in which a certain fraction of the captured electrons reach the ground state.

537.311.33 **599**

Theory of Hot-Electron Effects in Many-Valley Semiconductors in the Region of High Electric Field.—H. G. Reik, H. Risken & G. Finger. (*Phys. Rev. Lett.*, 1st Nov. 1960, Vol. 5, No. 9, pp. 423–425.)

537.311.33: 061.3 **600**

Physics of Semiconductors.—R. A. Smith. (*Nature, Lond.*, 19th Nov. 1960, Vol. 188, No. 4751, pp. 632–633.) Report of a conference held in Prague, 29th August–2nd September 1960.

537.311.33: 534.28 **601**

Interaction of Conduction Electrons with Acoustic Waves in Many-Valley Semiconductors.—N. Mikoshiba. (*J. phys. Soc. Japan*, July 1960, Vol. 15, No. 7, pp. 1189–1199.) A self-consistent semiclassical method is applied to many-valley semiconductors such as *n*-type Ge to clarify the characteristic features of the interaction of conduction electrons with acoustic waves.

537.311.33: 536.21.083 **602**

Measurement of Thermal Conductivity in Semiconductors.—R. Nii. (*Rev. elect. Commun. Lab., Japan*, March/April 1960, Vol. 8, Nos. 3/4, pp. 99–104.) Measurements on single crystals of Bi_2Te_3, PbTe and InSb in the temperature range 100°–600°K.

537.311.33: 538.632 **603**

Hall Field Relaxation in Semiconductors at High Frequency.—K. S. Champlin. (*J. appl. Phys.*, Oct. 1960, Vol. 31, No. 10, pp. 1770–1771.) "Using a simple extension of standard magnetoionic theory, the frequency dependence of the complex Hall field is calculated for samples with rectangular, cylindrical, and spherical geometry. The result has application to 'open circuit' Hall effect measurements on semiconductors at microwave frequencies."

537.311.33: 546.28 **604**

Resonant Spin-Spin Interaction between Donors and Acceptors in Silicon.—R. A. Levy. (*Phys. Rev. Lett.*, 1st Nov. 1960, Vol. 5, No. 9, pp. 425–427.)

537.311.33: 546.28 **605**

Valence Band Parameters in Silicon from Cyclotron Resonances in Crystals subjected to Uniaxial Stress.—J. C. Hensel & G. Feher. (*Phys. Rev. Lett.*, 1st Oct. 1960, Vol. 5, No. 7, pp. 307–309.)

537.311.33: 546.28 **606**

Paramagnetic Resonance Absorption from Acceptors in Silicon.—G. Feher, J. C. Hensel & E. A. Gere. (*Phys. Rev. Lett.*, 1st Oct. 1960, Vol. 5, No. 7, pp. 309–311.) The resonance signal is observed after the removal of the degeneracy of the valence band by subjecting *p*-type Si to uniaxial stress.

537.311.33: 546.28 **607**

Note on the Treatment of Impurity Scattering in Optical Absorption in Semiconductors.—B. Donovan. (*Proc. phys. Soc.*, 1st Oct. 1960, Vol. 76, No. 490, pp. 574–577.)

537.311.33: 546.28 **608**

Metal Precipitates in Silicon *p-n* Junctions.—A. Goetzberger & W. Shockley. (*J. appl. Phys.*, Oct. 1960, Vol. 31, No. 10, pp. 1821–1824.) The precipitates were found to cause excess reverse current below the avalanche breakdown. This current varies as V^n where $4 < n < 7$. 'Gettering' can be used to remove the precipitates.

537.311.33: 546.28: 535.215 **609**

Anomalous Surface Channels on Silicon *p-n* Junctions.—R. Solomon. (*J. appl. Phys.*, Oct. 1960, Vol. 31, No. 10, pp. 1791–1799.) Evidence is offered to show that multiple trapping of injected carriers occurs at surface interface states. A chopped monochromatic light source was directed on to the surface and the change of phase of the output current with movement of the surface compared against a reference source.

537.311.33: [546.289 + 546.28 **610**

Measurement of the Coefficient of Photoelasticity of Germanium.—C. Grandjean & F. Desvignes. (*C. R. Acad. Sci., Paris*, 15th Feb. 1960, Vol. 250, No. 7, pp. 1183–1185.) Description of a mounting used for studying the optical properties of Si and Ge.

537.311.33: 546.289 **611**

Oscillations in Germanium with an Applied Pulsed Electric Field.—M. Cardona & W. Ruppel. (*J. appl. Phys.*, Oct. 1960, Vol. 31, No. 10, pp. 1826–1827.) A report of current oscillations were observed in uniformly doped *p*-type Ge with rectifying contacts in the absence of a magnetic field. Voltages were measured across a 50-Ω load in series with the sample. A minimum of 30 V was required to produce oscillations and the frequency varied between 5 kc/s and 5 Mc/s, depending on the position of the contacts.

537.311.33: 546.289 **612**

Low-Temperature Impurity Conduction and Magnetoresistivity in *n*-Type Germanium.—P. Csavinszky. (*Phys. Rev.*, 1st Sept. 1960, Vol. 119, No. 5, pp. 1605–1609.) The resistivity of several lightly Sb-doped *n*-type Ge samples has been calculated and compared with values measured at 2·5°K. An order-of-magnitude agreement has been obtained. Similar agreement has been obtained for the magnetoresistive ratio.

537.311.33: 546.289 **613**

Effect of Shear on Impurity Conduction in *n*-Type Germanium.—H. Fritzsche. (*Phys. Rev.*, 15th Sept. 1960, Vol. 119, No. 6, pp. 1899–1900.) A method is described of studying the shape of the donor wave functions at large distances from the donor atom by means of the effect of shear stress on impurity conduction.

537.311.33: 546.289 **614**

Absorption Spectra and Zeeman Effect of Copper and Zinc Impurities in Germanium.—P. Fisher & H. Y. Fan. (*Phys. Rev. Lett.*, 1st Sept. 1960, Vol. 5, No. 5, pp. 195–197.)

537.311.33: 546.289 **615**

Interaction of High-Energy Phonons in Germanium.—G. Ascarelli. (*Phys. Rev. Lett.*, 15th Oct. 1960, Vol. 5, No. 8, pp. 367–369.) Transport of energy by phonons excited by hot electrons is observed experimentally. An average phonon energy and an average phonon mean free path are evaluated.

537.311.33: 546.289 **616**

A Reversed Carrier Transport Effect in Germanium.—A. C. Prior. (*Proc. phys. Soc.*, 1st Oct. 1960, Vol. 76, No. 490, pp. 465–480.) The variation of the electron/hole mobility ratio with electric field is theoretically and experimentally shown to influence substantially the motion of a density distribution in near intrinsic material at high fields. In *n*-type Ge the normal motion can be reversed and the possibility of injection or extraction from the negative end of an *n*-type specimen should be considered. An apparent negative resistance has been observed and a tentative explanation is given. Changes in mobility ratio with mechanical stress at high field levels have been investigated.

537.311.33: 546.289: 535.215 **617**

Interband Photoconductivity in Germanium.—T. S. Moss & T. D. H. Hawkins. (*Proc. phys. Soc.*, 1st Oct. 1960, Vol. 76, No. 490, pp. 565–566.) Interband photoconductivity has been observed by recording and comparing spectral sensitivity curves for specimens at room and at liquid-nitrogen temperatures. The time spent by a carrier in the split-off band before returning to the heavy-hole band is estimated to be 4 to 14×10^{-12} sec.

537.311.33: 546.289: 538.214 **618**

The Magnetic Susceptibility of Iron- and Zinc-Doped Germanium.—D. Geist. (*Z. Phys.*, 18th Feb. 1960, Vol. 158, No. 2, pp. 123–132.) The shift in diamagnetic susceptibility observed in Fe-doped single-crystal Ge is caused by ferromagnetic precipitates and is independent of the field. The suspected temperature dependence of susceptibility of Zn-doped material could not be measured owing to the low solubility of Zn. See also 232 of January.

537.311.33: 546.289: 538.569.4 **619**

New Electron Spin Resonance Spectrum in Antimony-Doped Germanium.—R. E. Pontinen & T. M. Sanders, Jr. (*Phys. Rev. Lett.*, 1st Oct. 1960, Vol. 5, No. 7, pp. 311–313.)

537.311.33: 546.289: 541.135 **620**

The Role of Subsidiary Electric Charge Carriers in the Anodic Dissolution of a Germanium Electrode.—Yu. V. Pleskov. (*Dokl. Ak. Nauk S.S.S.R.*, 21st June 1960, Vol. 132, No. 6, pp. 1360–1363.) Results of experiments show that for the passage of one Ge atom from the crystal lattice into solution the ratio of holes used is 2·4 and the ratio of electrons migrating to the conduction band is 1·6. Graphs show the variation of current multiplication in the *p-n* junction with illumination.

537.311.33: 546.47-31 **621**

Pressure Dependence of the Resistivity of Zinc Oxide.—A. R. Hutson, W. Paul, W. Howard & R. B. Zetterstrom. (*Z. Phys.*, 18th Feb. 1960, Vol. 158, No. 2, pp. 151–154. In English.) "The change of resistivity of *n*-type ZnO with hydrostatic pressure has been found to be $2{\cdot}2 \times 10^{-4}$/kg cm^{-2} and is nearly linear for pressures up to 28 000 kg/cm^2. This result can be shown to be incompatible with a simple model of electron mobility which assumes that the scattering due to acoustic modes arises from a deformation potential associated with lattice dilation."

537.311.33: 546.682'86 **622**

Anomalous Barrier Capacitance in *p-n* Junctions of InSb.—C. A. Lee & G. Kaminsky. (*J. appl. Phys.*, Oct. 1960, Vol. 31, No. 10, pp. 1717–1719.) Reverse-bias transition capacitance measurements on alloy diodes of InSb at 78 °K give values three times those calculated from normal diode theory.

537.311.33: 546.824-31 **623**

Anisotropic Conduction in Non-stoichiometric Rutile (TiO_2).—L. E. Hollander, Jr, & P. L. Castro. (*Phys. Rev.*, 15th Sept. 1960, Vol. 119, No. 6, pp. 1882–1885.) Measurements are reported and discussed in relation to conflicting published results.

537.311.33:[546.873'241 + 546.863'241 **624**

Dislocation Nets in Bismuth and Antimony Tellurides.—P. Delavignette & S. Amelinckx. (*Phil. Mag.*, July 1960, Vol. 5, No. 55, pp. 729–744.)

537.311.33: 546.873'241 **625**

Infrared Faraday Rotation and Free Carrier Absorption in Bi_2Te_3.—I. G. Austin. (*Proc. phys. Soc.*, 1st Aug. 1960, Vol. 76, No. 488, pp. 169–179.)

537.312.62: 539.23 **626**

Critical Fields of Thin Superconducting Films.—W. B. Ittner, III. (*Phys. Rev.*, 1st Sept. 1960, Vol. 119, No. 5, pp. 1591–1596.) The critical fields of thin superconducting films have been calculated on the basis of the Bardeen-Cooper-Schrieffer theory (1386 of 1958).

537.583 **627**

Density of a Thorium Monolayer for Maximum Thermionic Emission.—W. E. Danforth & D. L. Goldwater. (*J. appl. Phys.*, Oct. 1960, Vol. 31, No. 10, pp. 1715–1717.) The surface density is measured by a high-sensitivity analytical balance.

538.221 **628**

Anisotropy of the Intrinsic Domain Magnetization of a Ferromagnet.—S. H. Charap. (*Phys. Rev.*, 1st Sept. 1960, Vol. 119, No. 5, pp. 1538–1542.)

538.221 **629**

Eddy-Current Effects in Rectangular Ferromagnetic Rods.—E. W. Lee. (*Proc. Instn elect. Engrs*, Part C, Sept. 1960, Vol. 107, No. 12, pp. 257–264.) Theoretical investigation of eddy-current distributions and the resulting loss angles.

538.221 **630**

Internal Ferromagnetic Resonance and Magnetostatic Modes in Nickel-Iron Alloys.—J. C. Anderson. (*Proc. phys. Soc.*, 1st Aug. 1960, Vol. 76, No. 488, pp. 273–281.) See also 1705 of 1960.

538.221 **631**

The Magnetization of Ferromagnetic Binary Alloys of Cobalt or Nickel with Elements of the Palladium and Platinum Groups.—J. Crangle & D. Parsons. (*Proc. roy. Soc. A*, 10th May 1960, Vol. 255, No. 1283, pp. 509–519.)

538.221 **632**

Bloch Wall Spacing in Thin SiFe Specimens of Cubic Texture.—R. Brenner. (*Z. angew. Phys.*, March 1960, Vol. 12, No. 3, pp. 107–111.)

538.221 **633**

The Ferromagnetism of the Compound γ-FeSn.—M. Asanuma. (*J. phys. Soc. Japan*, July 1960, Vol. 15, No. 7, p. 1343.)

538.221: 537.312.62 **634**

Properties of some Magnetic Superconductors.—R. M. Bozorth, D. D. Davis & A. J. Williams. (*Phys. Rev.*, 1st Sept. 1960, Vol. 119, No. 5, pp. 1570–1576.) Solid solutions in the system $GdRu_2$-$CeRu_2$, in which both ferromagnetism and superconductivity have been observed are studied by magnetic methods.

538.221: 538.652 **635**

The Saturation Magnetostriction Constants of Nickel within the Temperature Range −196° to 365°C.—R. R. Birss & E. W. Lee. (*Proc. phys. Soc.*, 1st Oct. 1960, Vol. 76, No. 490, pp. 502–506.)

538.221: 538.653.1 **636**

The Remanence Characteristics of Stretched Polycrystalline Nickel Wires.—C. Schwink & G. Zankl. (*Z. Phys.*, 18th Feb. 1960, Vol. 158, No. 2, pp. 181–195.) Remanence was measured as a function of previously applied and removed tensile stress.

538.221: 539.23 **637**

Formation of Very Thin Films of Nickel. Action of an Electric Field. Results.—A. Colombani & G. Goureaux. (*C. R. Acad. Sci., Paris*, 15th Feb. 1960, Vol. 250, No. 7, pp. 1264–1266.)

538.221: 539.23 **638**

Oblique-Incidence Anisotropy in Evaporated Permalloy Films.—D. O. Smith, M. S. Cohen & G. P. Weiss. (*J. appl. Phys.*, Oct. 1960, Vol. 31, No. 10, pp. 1755–1762.)

538.221: 539.23 **639**

Magnetization Reversal of Thin Magnetic Films in the Nanosecond Range.—W. Dietrich & W. E. Proebster. (*Elektronische Rundschau*, Feb. 1960, Vol. 14, No. 2, pp. 47–49.) See 2843 of 1960 and also 3591 of 1960 (Dietrich et al.).

538.221: 539.23: 621.385.833 **640**

Domains in Thin Magnetic Films Observed by Electron Microscopy.—H. W. Fuller & M. E. Hale. (*J. appl. Phys.*, Oct. 1960, Vol. 31, No. 10, pp. 1699–1705.) A new method for observing full domains in thin films, using an off-centre objective aperture diaphragm as a knife edge.

538.221: 621.318.124 **641**

Ceramic Permanent Magnets.—J. W. Bunn & J. Harrison. (*Wireless World*, Dec. 1960, Vol. 66, No. 12, pp. 595–598.) A comprehensive review of the magnetic properties of Ba ferrite, and the manufacture and design details for permanent magnets are given. Various practical applications are discussed.

538.221: 621.318.134 **642**

The Ferrimagnetism of Nonstoichiometric Iron Sulphides.—R. Perthel. (*Ann. Phys., Lpz.*, 8th Feb. 1960, Vol. 5, Nos. 5/6, pp. 273–295.)

538.221: 621.318.134 **643**

The *kπ* Walls in Ferrites.—M. Paulus. (*C. R. Acad. Sci., Paris*, 15th Feb. 1960, Vol. 250, No. 7, pp. 1213–1215.) Report of powder-pattern investigations of the magnetization of single-crystal Ni ferrite containing $< 0{\cdot}05\%$ Co, relating to the formation of multiple domain walls.

538.221: 621.318.134 **644**

Exchange Interaction and Cubic Crystal Field Splitting Parameter of Fe^{3+} in Spinel Structure.—Y. Sugiura. (*J. phys. Soc. Japan*, July 1960, Vol. 15, No. 7, pp. 1217–1222.)

538.221: 621.318.134 **645**

Classical Theory of Spin Configurations in the Cubic Spinel.—T. A. Kaplan. (*Phys. Rev.*, 1st Sept. 1960, Vol. 119, No. 5, pp. 1460–1470.)

538.221: 621.318.134 **646**

Magnetic Properties of Mn_3O_4 and the Canted-Spin Problem.—K. Dwight & N. Menyuk. (*Phys. Rev.*, 1st Sept. 1960, Vol. 119, No. 5, pp. 1470–1479.)

538.221 : 621.318.134 **647**

Adiabatic Demagnetization and Specific Heat in Ferrimagnets.—J. E. Kunzler, L. R. Walker & J. K. Galt. (*Phys. Rev.*, 1st Sept. 1960, Vol. 119, No. 5, pp. 1609–1614.)

538.221 : 621.318.134 **648**

Magnetic Properties and Ferrimagnetic Resonance in Polycrystalline $3Y_2O_3 . (5-x)Fe_2O_3 . xIn_2O_3$.—Y. Shichijo & T. Miyadai. (*Rev. elect. Commun. Lab., Japan*, Jan./Feb. 1960, Vol. 8, Nos. 1/2, pp. 12–17.)

538.221 : 621.318.134 **649**

Measurement of the Complex Permittivity and the Permeability Tensor of Ferrites in the Millimetre Wave Range.—D. I. Mash & V. V. Nikol'skii. (*Zh. tekh. Fiz.*, Sept. 1959, Vol. 29, No. 9, pp. 1070–1073.) Graphs show the dependence of the components of the permeability tensor on the intensity of the constant magnetic field.

538.221 : 621.318.134 : 538.569.4 **650**

Ferromagnetic Resonance in Polycrystalline Ferrites.—J. Snieder. (*Appl. sci. Res.*, 1958, Vol. B7, No. 3, pp. 185–232.) An experimental and theoretical study is made of the propagation of TE_{11} waves of wavelength 3·2 cm in a circular waveguide containing a rod of Ferroxcube IV magnetized by a static magnetic field in a longitudinal direction.

538.221 : 621.318.134 : 538.569.4 **651**

Interaction between High-Power Microwave Losses and Magnetic Flux Reversal.—E. M. Gyorgy & F. B. Hagedorn. (*J. appl. Phys.*, Oct. 1960, Vol. 31, No. 10, pp. 1775–1778.) Experiments on polycrystalline ferrite show that the spin waves associated with high-power off-resonance microwave absorption have a negligible effect on the flux reversal process. The latter has a marked effect on the high-power microwave loss.

538.221 : 621.318.134 : 538.569.4 **652**

Anisotropic Ferromagnetic Resonance Line Width in Ferrites.—H. B. Callen & E. Pittelli. (*Phys. Rev.*, 1st Sept. 1960, Vol. 119, No. 5, pp. 1523–1531.) The source of resonance line width in disordered magnetic materials such as ferrites is discussed theoretically.

538.221 : 621.318.134 : 538.569.4 **653**

Magnetic Resonance and Magnetocrystalline Anisotropy in Ytterbium Iron Garnet.—R. F. Pearson & R. W. Teale. (*Proc. phys. Soc.*, 1st Aug. 1960, Vol. 76, No. 488, pp. 308–310.) A note of anomalous anisotropic resonance behaviour observed in measurements on $Yb_3Fe_5O_{12}$.

538.221 : 621.318.134 : 538.652 **654**

Ultrasonic Measurement of Magnetization in Mn-Ferrite Single Crystal.—K. Husimi, K. Nishiguchi & T. Suzuki. (*J. phys. Soc. Japan*, July 1960, Vol. 15, No. 7, p. 1341.) An ultrasonic method [3857 of 1958 (Husimi & Kataoka)] is shown to be adequate for measurement of magnetization without disturbing the domain configuration.

538.221 : 621.395.625.3 **655**

The Anhysteretic Remanence of Magnetic Recording Tapes.—E. P. Wohlfarth. (*Phil. Mag.*, July 1960, Vol. 5, No. 55, pp. 717–722.) The anhysteretic properties are discussed by introducing the idea of internal demagnetization spectra.

538.222 : 538.569.4 **656**

Cross-Relaxation Effect of Chromium and Iron in $K_3(Co, Cr, Fe)(CN)_6$.—J. M. Minkowski. (*Phys. Rev.*, 1st Sept. 1960, Vol. 119, No. 5, pp. 1577–1578.)

538.222 : 538.569.4 : 535.37 **657**

Coherence, Narrowing, Directionality, and Relaxation Oscillations in the Light Emission from Ruby.—R. J. Collins, D. F. Nelson, A. L. Schawlow, W. Bond, C. G. B. Garrett & W. Kaiser. (*Phys. Rev. Lett.*, 1st Oct. 1960, Vol. 5, No. 7, pp. 303–305.) The coherence and directionality of the radiation are experimentally verified and the line width measured. Relaxation oscillation has been observed in the fluorescence.

548.0 **658**

On Dislocations Formed by the Collapse of Vacancy Discs.—C. Elbaum. (*Phil. Mag.*, July 1960, Vol. 5, No. 55, pp. 669–674.) The formation of dislocations by the collapsing-vacancy-disk mechanism is examined for Al, Cu, Si and Ge.

621.791.76 : 537.322.1 **659**

Investigations of the Influence of the Peltier Effect on Resistance Welds.—S. Scholz. (*Z. angew. Phys.*, March 1960, Vol. 12, No. 3, pp. 111–117.) The strength of welds between metals which differ thermoelectrically depends on the direction of the welding current. The magnitude of this effect is calculated and confirmed by experimental results.

MATHEMATICS

512.8 **660**

Multiple Products of Matrices of General Form.—M. Dreikorn & F. Stockinger. (*Arch. elekt. Übertragung*, Feb. 1960, Vol. 14, No. 2, pp. 54–56.) A general scheme of calculation is illustrated by a numerical example.

517.524 : 621.372.4 **661**

Further Theory of a Certain Continued Fraction.—O. P. D. Cutteridge. (*Proc. Instn elect. Engrs*, Part C, Sept. 1960, Vol. 107, No. 12, pp. 234–237.) Extension to the determination of the zeros of a polynomial, illustrated by a numerical example in linear-network theory.

MEASUREMENTS AND TEST GEAR

531.76 : 621.374.33 : 621.385 **662**

Time Analyser using a Crystal-Controlled Trochotron Tube.—T. Dobrowolski & J. Walker. (*J. sci. Instrum.*, Aug. 1960, Vol. 37, No. 8, pp. 289–291.) A nine-channel timing system is described in which the output of a crystal oscillator is switched by a starting signal and then applied to a beam-switching tube which produces impulses to control the circuits which gate the signals to be timed.

621.317.328.029.6 **663**

On Measurements of Microwave $\overline{E}$ and $\overline{H}$ Field Distributions by using Modulated Scattering Methods.—M. K. Hu. (*Trans. Inst. Radio Engrs*, May 1960, Vol. MTT-8, No. 3, pp. 295–300. Abstract, *Proc. Inst. Radio Engrs*, Aug. 1960, Vol. 48, No. 8, p. 1515.)

621.317.335.3 : 621.372.413 **664**

A New Cavity-Resonator Method for Measuring Permittivity.—J. K. Sinha & J. Brown. (*Proc. Instn elect. Engrs*, Part B, Nov. 1960, Vol. 107, No. 36, pp. 522–530.) A cylindrical-rod specimen is inserted into the cavity, and the permittivity is derived from a plot of cavity length at resonance against length of rod inserted. The advantages of the method are discussed.

621.317.335.3.029.6 : 621.372.826 **665**

Application of Slow Surface Waves for the Measurement of Dielectric Constants of Substances at Ultra High Frequencies: Part 2.—V. P. Shestopalov & K. P. Yatsuk. (*Zh. tekh. Fiz.*, Sept. 1959, Vol. 29, No. 9, pp. 1090–1099.) An extension of the method described in Part 1 (3984 of 1960) to liquid dielectrics in the dm-λ range.

621.317.335.3.029.6 : 621.372.826 **666**

Application of Slow Surface Waves for the Measurement of Dielectric Constants of Substances at Ultra High Frequencies: Part 3.—V. P. Shestopalov, K. P. Yatsuk & I. P. Yakumenko. (*Zh. tekh. Fiz.*, Nov. 1959, Vol. 29, No. 11, pp. 1330–1338.) The method is generalized for application to dielectrics with small losses. Formulae are derived for determining the loss angle of solid cylindrical samples and liquids. Part 2: 665 above.

621.317.42 **667**

Investigation of Plane-Parallel Fields by means of Analogue Electrical Flux Fields.—E. Schütz. (*Arch. tech. Messen*, Feb. 1960, No. 289, pp. 25–26.) The distribution of current flow in a metal foil is used as an analogue for the purpose of magnetic-field plotting.

621.317.44 : 537.525 **668**

Magnetic Probes of High Frequency Response.—S. E. Segre & J. E. Allen. (*J. sci. Instrum.*, Oct. 1960, Vol. 37, No. 10, pp. 369–371.) Magnetic field distributions in pulsed discharges can be measured by probes having a response which is uniform within 1%, up to 20 Mc/s.

621.317.7 : 621.372.44 **669**

A Theory of Steady Forces in Variable-Parameter Networks.—W. E. Smith. (*Proc. Instn elect. Engrs*, Part C, Sept. 1960, Vol. 107, No. 12, pp. 228–233.) The theory is applicable for the absolute calibration of square-law measuring instruments.

621.317.7 : 621.391.822.029.64 : 621.387 **670**

Noise Generators for Centimetre Waves.—R. Saier. (*Frequenz*, Feb. 1960, Vol. 14, No. 2, pp. 68–70.) The use of gas-discharge tubes as noise sources is considered; two generators for use respectively at 3·3–4·9 and 5·85–8·2 Gc/s are described.

621.317.7.029.64 : 621.316.72 **671**

A Power Stabilizer for Frequency-Modulated Microwave Oscillators.—H. A. Dijkerman, C. Huisman & A. Dymanus. (*Appl. sci. Res.*, 1959, Vol. B8, No. 1, pp. 1–7.) Description of a power stabilizer for the 1·25-cm-λ region which uses a ferrite modulator of special design and has a time constant of 10^{-4} sec.

621.317.723 : 551.508.94 **672**

A Double Field Mill for the Measurement of Potential Gradients in the Atmosphere.—D. R. Currie & K. S. Kreichelmer. (*J. atmos. terr. Phys.*, Oct. 1960, Vol. 19, No. 2, pp. 126–135.) It is possible to measure either the atmospheric potential gradient or the self-charge of the equipment.

621.317.733 **673**

Two-Signal Bridges.—G. W. Short. (*Electron. Technol.*, Dec. 1960, Vol. 37, No. 12, pp. 452–455.) The use of two oscillators of different frequencies enables the input and output of the bridge to have a common terminal.

621.317.7[illegible] **674**

An Instrument for the Automatic Determination of the Imaginary Part from the Real Part, and vice versa, for Network Functions of the Minimum-Phase Type.—V. Polisi. (*Hochfrequenztech. u. Elektroakust.*, Feb. 1960, Vol. 69, No. 1, pp. 7–13.)

621.317.77 **675**

Ratiometer Phase Angle Indicator.—R. L. Shipley. (*J. sci. Instrum.*, Aug. 1960, Vol. 37, No. 8, pp. 300–302.) The principles of operation of a moving-coil ratiometer and associated circuits are described and performance, adjustment and calibration details of the complete instrument are given.

OTHER APPLICATIONS OF RADIO AND ELECTRONICS

535.376.07 **676**

Increasing the Brightness-Voltage Nonlinearity of Electroluminescent Devices.—J. A. O'Connell & B. Narken. (*IBM J. Res. Develpm.*, Oct. 1960, Vol. 4, No. 4, pp. 426–429.) Marked improvement in the brightness/voltage nonlinearity and greatly enhanced discrimination ratios can be obtained by the inclusion of SiC resistive layers in series with electroluminescent elements.

551.508.822 **677**

Meteorological Measurement Techniques in the Free Atmosphere.—M. Hinzpeter. (*Elektrotech. Z., Edn B*, 22nd Feb. 1960, Vol. 12, No. 4, pp. 73–77.) Details are given of the German radiosonde Type M59 and of radiosondes in use in other countries.

621.385.833 **678**

The Depth of Focus of Electron-Optical Images obtained by Electrostatic Immersion Objectives.—G. Bartz. (*Optik, Stuttgart, March 1960, Vol. 17, No. 3*, pp. 135–142.) An approximation formula is derived for the depth of focus. Illustrations show a fivefold improvement in depth of focus relative to an optical microscope when an e.s. immersion objective is used in a secondary-electron microscope.

621.398 : 623.451-519 **679**

Miniaturized Autopilot System for Missiles.—J. H. Porter. (*Electronics*, 21st Oct. 1960, Vol. 33, No. 43, pp. 60–64.) A detailed description of the electronic system which provides a series of control conditions during a 2 000-sec launch period. A magnetic shift register is used for programming flight operations.

PROPAGATION OF WAVES

621.391.812.62.029.62 **680**

The Installation of a 3 045-c/s Leak between Prague and Radiocommunication Station Podebrady.—F. Beckmann & J. Krátký. (*Radiotechnika, Prague*, Feb. 1960, Vol. 9, No. 2, pp. 71–79.) Field-strength measurements at Podebrady for transmissions at 2 245 Mc/s over a 240-km path are discussed. See also 1758 of 1960 (Kalbe).

621.391.812.62.029.63 **681**

Data on Microwave Propagation for Ground Stations in the Delhi Area.—S. Ghosh. (*Proc. Inst. Radio Engrs, Aust.*, Dec. 1960, Vol. 21, No. 12, pp. 11–21.) Microwave propagation tests in the 2-Gc/s region have been made between Landour and New Delhi, India, over a distance of 258 km. Very strong night-time signals are shown to be due to atmospheric temperature inversion.

621.391.812.624.029.63 **682**

A Note on Scatter Propagation.—S. J. Martin. (*Proc. Inst. Radio Engrs*, Nov. 1960, Vol. 48, No. 11, pp. 1915–1916.) Some results are given for a 136-mile, 400- and 800-Mc/s scatter link. These include data on frequency-selective fading, the effect of beam width on path multiplication and the variation of fading rates with aerial elevation.

621.391.812.624.029.64 **683**

Propagation Measurements at 3 680 and 9 040 Mc/s beyond the Radio Horizon.—G. V. Geiger, N. D. La Fremain & W. J. Lucas. (*Proc. Instn elect. Engrs*, Part B, Nov. 1960, Vol. 107, No. 36, pp. 531–546.) Describes long-term measurements of median level and fading characteristics, mainly over path lengths of 173 and 247 miles. For a considerable time the X- and S-band transmissions were made simultaneously over the same link. Aerial siting tests were also made. See also 2000 *c* of 1959 (Angeli *et al.*).

621.391.812.63 **684**

The Variation of the Rate of Fading with Frequency.—B. N. Singh & O. P. Sinha. (*J. atmos. terr. Phys.*, Oct. 1960, Vol. 19, No. 2, pp. 141–143.) The number of peaks per hour is given by $0{\cdot}3f\sin i$ where f is the operating frequency and i the angle of incidence at the ionosphere.

621.391.812.63.029.54 **685**

The Fading of Low-Frequency Radio Waves Reflected from the Ionosphere.—W. A. Gilliers. (*J. atmos. terr. Phys.*, Oct. 1960, Vol. 19, No. 2, pp. 102–114.) On all frequencies between 70 and 200 kc/s there is evidence of a quasi-periodic fading component of period roughly 7·5 min. This seems to be due to a quasi-sinusoidal irregularity in the ionosphere having a spatial period of order 20 km and a speed of 35 m/s.

RECEPTION

621.391.812.63 : 621.3.018.41(100.74) **686**

Continuous Recordings of the Frequency Variation of the 9·915-Gc Signal after Propagation over a 1 000-km Path.—A. A. Oswald & G. G. Gilbert. (*J. geophys. Res., Wash.*, Dec. 1960, Vol. 65, No. 12, pp. 3989–3996.) Shifts of 1 part in 10^7 were observed morning and evening. During magnetic disturbances shifts of 5 parts in 10^7 were found.

621.391.812.63.029.62 **687**

6·05-Mc/s and 9-Mc/s Reception over Great Distances.—J. Rankin & A. Schwarz. (*Radiotekhn. Elektron. Akad. SSSR*, 1960, Vol. 10, No. 1, pp. 46–56.) Report on observations in Russia of conditions receptive in the frequency range 26–140 Mc/s during the period 1956 September–1959.

621.391.82 : 551.510.5 **688**

Observations of Earth-Ionosphere Cavity Resonances.—M. Balser & C. A. Wagner. (*Nature, Lond.*, 19th Nov. 1960, Vol. 188, No. 4753, pp. 638–641.) Report of equipment used and results obtained from experiments to observe cavity effects in the region of the theoretical fundamental mode frequency of 10·6 c/s. Final results, produced by simulated spectrum analysis on a digital computer give five resonance modes in the range 5–50 c/s with a frequency of 7·8 c/s for the first peak and $Q = 4$ for the cavity. See 4382 of 1960 for a report of earlier work.

621.396.62.029.62 : 621.391.822 **689**

The Technique of Low-Noise Input Circuits in the 100-Mc/s Region.—E. Cantz. (*Telefunken-Röhre*, Jan. 1960, No. 35a, pp. 105–146.) The relative importance of aerial noise and the low noise figure of an f.m. receiver input stage is discussed. Several

modern input circuits are described, and the influence of aerial bandwidth on the noise figure of v.h.f. receivers is considered.

STATIONS AND COMMUNICATION SYSTEMS

621.376: 621.396: 681.84.087.7 [678]

Interrelation and Combination of Various Types of Modulation.—W. D. Mewhinney. (*Proc. Inst. Radio Engrs*, Nov. 1960, Vol. 48, No. 11, pp. 1829–1832.) Report. See 2157 of 1960.

621.376.3 [679]

R. F. Spectra of Wave Frequency-Modulated with White Noise.—R. G. Medhurst. (*Proc. Instn elect. Engrs*, Part C, Sept. 1960, Vol. 107, No. 33, pp. 314–323.) Results of analyses are presented as curves covering the range of modulation parameters likely to be found in multichannel radiotelephone systems using frequency-division multiplex. See also 2160 of 1958 (Medhurst *et al.*).

621.391 [680]

Traffic Efficiencies in Congested Band Radio Systems.—J. H. Weber, J. F. Cotton. (*Proc. Inst. Radio Engrs*, Nov. 1960, Vol. 48, No. 11, pp. 1939–1951.) Comment on 1951 of 1959 and author's reply.

621.391 [681]

Facsimile Codes.—H. D. Hammond. (*Proc. Instn elect. Engrs*, Part B, Sept. 1960, Vol. 107, No. 33, pp. 450–456.) Discussion of the use of unit code functions for non-binary code alphabets.

621.396.65: 621.396.69 [682]

Position Allocation for In-Line Collectives in Switched Multiple Systems.—M. Alexandre. (*Onde Elect.*, Jan. 1960, Vol. 40, No. 1, pp. 30–38.) Identifying problems in multi-link multichannel communication systems are investigated. See also 1156 of 1959.

621.396.712 [683]

Planning and Installation of the Naval Broadcasting Headquarters for the S.H.A.P.E. Overseas and European Services.—F. Jones & O. H. Barton. (*Proc. Instn elect. Engrs*, Part B, Nov. 1960, Vol. 107, No. 36, pp. 485–496. Discussion, pp. 496–498.)

621.396.722: 551.5 [684]

The Radio Receiving Station of the German Meteorological Service in Offenbach a.M.—K. Fischer & P. Wojtzoff. (*Elektrotech. Z., Edn B*, 22nd Feb. 1960, Vol. 12, No. 4, pp. 70–82.) The design and equipment of the central receiving station for weather reports are discussed.

621.396.722: 621.391.812.63 [685]

Improved Communications using Ground Scatter Propagation.—E. T. Wolfram. (*Electronics*, 28th Oct. 1960, Vol. 33, No. 44, pp. 74–78.) Description of a 'pin-wheel sounder' for propagation research giving a c.r.o. display of signal azimuth.

621.396.934 [686]

Missile Communication during Reentry Blackout.—K. M. Baldwin, O. E. Bassett, E. I. Hawthorne & E. Langberg. (*Electronics*, 27th May 1960, Vol. 33, No. 22, pp. 105–109.) The choice of a sufficiently high communication frequency and other special features of the telemetry transmitting and receiving equipment are considered which are intended to overcome the blackout effect due to plasma sheath formation.

621.396.97 [687]

Methods of Obtaining an Optimum Monophonic Broadcast Transmission System.—G. Steinke. (*Tech. Mitt. RRF, Berlin*, March 1960, Vol. 4, No. 1, pp. 21–32.) Listening conditions in the home, the characteristics of monitoring installations, and broadcast recording techniques are discussed. 10 references.

621.396.97: 621.376 [688]

Stereophonic Broadcasting using Pulse Amplitude Modulation.—H. F. Mayer & F. Bath. (*Rundfunktech. Mitt.*, Aug. 1960, Vol. 4, No. 4, pp. 170–176.) A time-multiplex p.a.m. method compatible with normal reception and requiring a single channel of slightly greater bandwidth is described. See also 598 of January (Jaeger).

[illegible]

621.[illegible] [689]

The Stabilization of Control Systems with Switch using a High-Frequency On/Off Loop.—[illegible]. (*Proc. Instn elect. Engrs*, Part C, Sept. 1960, Vol. 107, No. 33, pp. 348–355.) The conditions [illegible] and to which the system moves together to the quasi-stationary line center and load each is separated.

621.[illegible] [690]

The Effect of an Additional Time-Constant on the Performance of Pulse-Controlled Control Systems Subjected to Random Inputs.—J. L. Dixon & R. E. King. (*Proc. Instn elect. Engrs*, Part C, Sept. 1960, Vol. 107, No. 33, pp. 340–347.) The addition of a nonlinear error detector gives an improved response.

621.[illegible] [691]

A Calculation of Switching Functions on a Theme of Minimizing Error in an On/Off Control System.—R. E. Brown. (*Proc. Instn elect. Engrs*, Part C, Sept. 1960, Vol. 107, No. 33, pp. 249–256.) Adaptive switching functions are discussed and the principles illustrated on a mathematical model of an ideal servomechanism.

621.[illegible] [692]

Extension of the Dual-Input Describing-Function Technique to Systems containing Reactive Non-linearity.—E. M. Huey, O. Pawloff & T. Glucharoff. (*Proc. Instn elect. Engrs*, Part C, Sept. 1960, Vol. 107, No. 33, pp. 330–341.) An extension of the work of Koschenburger (see e.g. 2218 of 1951) and of West *et al.* (3223 of 1956), enabling the nonlinear coefficient to be associated with any term in the differential equation.

621.316.722.078 [693]

The Stabilization of Direct-Voltage Supplies.—R. Casagrad, G. Giradi & Y. Sevely. (*C. R. Acad. Sci., Paris*, 15th Feb. 1960, Vol. 250, No. 7, pp. 1210–1220.) A functional diagram is prepared for studying the control and stabilization of a d.c. supply system under load and no-load conditions.

621.318.57: 621.314.63 [694]

Designing Gold-Bonded Germanium Power Relays.—R. F. Blake. (*Electronics*, 27th May 1960, Vol. 33, No. 22, pp. 114–117.) The performance and design of relay circuits using Ni controlled rectifiers is considered.

621.362: 621.387 [695]

Construction of a Ultrasonic Energy Converter.—F. G. Block, F. H. Corrigan, G. V. Eastman, J. R. Frankel, R. G. Hennigar & E. J. Hills. (*Proc. Inst. Radio Engrs*, Nov. 1960, Vol. 48, No. 11, pp. 1866–1872.) Discussion of design data for a Cavagnan type of energy converter. The construction and tuning of a high-power unit is described.

[illegible]

621.397: 621.391.8 [696]

Observations of Television Reception in Band IV.—[illegible]. (*Proc. Instn elect. Engrs*, Part B, Nov. 1960, Vol. 107, No. 36, pp. 499–506.) Report of measurements made in the Hamburg area using band-IV and band-V transmitters, and on experimental colour television transmissions in Radio West Germany using a modified 625-line system. Band-IV propagation appears satisfactory apart from ghosts caused by reflections.

621.397.13 [697]

Cassette Equipment.—V. N. Watson. (*J. Brit. Instn Radio Engrs*, Oct. 1960, Vol. 20, No. 10, pp. 759–768.) Television tape techniques enable short lengths of 16-mm film to be copied. The system described records in approximately 1 hour over a mile (about a length of film corresponding to about 30 sec of television time).

621.397.132 [698]

Choice de France Colour Television System.—R. Chauvin & P. Camagne. (*Proc. Instn elect. Engrs*, Part B, Nov. 1960, Vol. 107, No. 36, pp. 499–507. Discussion, pp. 507–513.) A description of the 'Secam' system. The luminance-signal component is transmitted over a wide band for all scanning lines but each of the two complementary chrominance-signal components is trans-

mitted, in a narrow band, over alternate lines. An encoding system enabling signals to be transmitted over existing links is outlined, together with the design of a suitable compatible 625-line receiver incorporating a 64-μs delay line for storing alternate chrominance scans: no synchronous detector is used, as in the N.T.S.C. system. The system was demonstrated by relaying a program from Paris to London over the existing Eurovision link. See also 3660 of 1960.

621.397.132: 535.62 **711**

Colour Television—with Two Primary Colours?—P. Neidhardt. (*Radio u. Fernsehen*, Feb. 1960, Vol. 9, No. 4, pp. 103–106.) Land's theory of colour vision and its unsuitability for practical application are discussed. See also 341 of January.

621.397.61 **712**

The Influence of the Camera Optical System on a Television Channel.—D. Frenzel. (*Nachrichtentech. Z.*, Jan. 1960, Vol. 13, No. 1, pp. 1–8.) Measurements were made on several lens systems to determine the relation between optical parameters and the quality of television reproduction. See also 3995 of 1958. 24 references.

621.397.61 **713**

The Sync-Pulse Separator Stage in Monochrome Television Transmitters.—G. Coldewey. (*Frequenz*, Feb. 1960, Vol. 14, No. 2, pp. 56–58.) Two diode pulse-separator circuits are discussed whose linearity can be improved by using a Ge diode instead of an oxide-cathode type.

621.397.62: 621.396.669 **714**

Television Noise Limiting.—H. D. Kitchin. (*Electronic Technol.*, Nov. & Dec. 1960, Vol. 37, Nos. 11 & 12, pp. 406–414 & 455–459.) The operation of two simple types of noise limiter for an a.m. sound channel is analysed and an improved circuit with variable bias is described. Design equations are given and the influence of pulse shape and factors affecting overall noise performance are discussed.

621.397.62.001.4: 621.391.823 **715**

A Controlled Interference Generator.—W. E. Matthews & P. L. Mothersole. (*Electronic Engng*, Nov. 1960, Vol. 32, No. 393, pp. 685–688.) Realistic interference signals used for investigating the performance of television receivers are generated from an electric motor and a motor-car ignition simulator. Details of the circuit and construction are given.

621.397.621 **716**

Theoretical Investigations of the Sync Separator Stage in Television Receivers.—H. Reker. (*Nachrichtentech. Z.*, March 1960, Vol. 13, No. 3, pp. 147–154.) The importance of the coupling filter between video output stage and sync separator is discussed. The designs of two types of filter are given.

621.397.74 **717**

Method for Planning Optimum Transmitter Networks for Television Coverage in Bands IV and V. (Description of the Method and Indications for its Use).—H. Eden, H. W. Fastert & K. H. Kaltbeitzer. (*Rundfunktech. Mitt.*, Feb. 1960, Vol. 4, No. 1, pp. 4–22.) The method described is suitable for transmitters of equal or differing e.r.p. For English version see *E.B.U. Rev.*, Feb. 1960, No. 59A, pp. 6–21. See also 348 of January (Eden & Kaltbeitzer).

621.397.74 **718**

Technical Peculiarities of the Swiss Television Network.—H. A. Lacett. (*Rundfunktech. Mitt.*, Feb. 1960, Vol. 4, No. 1, pp. 31–34.) Problems arising from the trilingual culture and mountainous nature of the country are considered.

TRANSMISSION

621.396.61: 621.395.665.1 **719**

A Compandor for Broadcast Transmission.—W. von Guttenberg & H. Hochrath. (*Nachrichtentech. Z.*, Jan. 1960, Vol. 13, No. 1, pp. 9–15.) Several types of compandor are reviewed with reference to the C.C.I.T.T. requirements. A syllable compandor operating at carrier-frequency level has given satisfactory results under experimental conditions. See 4055 of 1960.

VALVES AND THERMIONICS

621.382.2/.3 **720**

Lumped-Model Analysis of Space-Charge Widening.—J. F. Gibbons & D. A. Linden. (*Proc. Inst. Radio Engrs*, Nov. 1960, Vol. 48, No. 11, p. 1920.) Lumped constants are used to represent transistors and diodes in the analysis.

621.382.23 **721**

Pulse Characteristics of p-n Junctions.—E. Köhler. (*Nachr Tech.*, Feb. 1960, Vol. 10, No. 2, pp. 62–67.) Calculations of p-n junction performance under conditions of signal reversal are based on experimental investigations of current characteristics as a function of circuit parameters.

621.382.23 **722**

Estimation of High-Frequency Properties of the Thermal-Avalanche Negative-Resistance Diode.—J. Nishizawa. (*Sci. Rep. Res. Inst. Tohoku Univ., Ser. B*, 1959, Vol. 11, No. 1, pp. 1–9.) Discussion of thermal effects and an equivalent-circuit analysis to determine the upper frequency limit of operation.

621.382.23: 539.12.04 **723**

Fast Neutron Bombardment of Germanium and Silicon Esaki Diodes.—J. W. Easley & R. R. Blair. (*J. appl. Phys.*, Oct. 1960, Vol. 31, No. 10, pp. 1772–1774.) The main result of the bombardment is the increase in the 'excess' current which is proportional to integrated neutron flux. Substantial changes also occur in the I/V characteristics for exposures between 10^{15} and 10^{17} fast neutrons/cm^2.

621.382.23: 621.372.44 **724**

***P-N-P* Variable-Capacitance Diode Theory.**—J. M. Early. (*Proc. Inst. Radio Engrs*, Nov. 1960, Vol. 48, No. 11, pp. 1905–1906.) An analysis of steady-state r.f. operation.

621.382.23: 621.375.9 **725**

Negative-Resistance Amplifier Design.—J. B. Schultz & H. B. Yin. (*Electronics*, 27th May 1960, Vol. 33, No. 22, pp. 110–112.) Design criteria are given for amplifiers using tunnel diodes or four-layer transistor diodes.

621.382.23: 621.376.23 **726**

Esaki Diodes as Superregenerative Detectors.—A. G. Jordan & R. Elco. (*Proc. Inst. Radio Engrs*, Nov. 1960, Vol. 48, No. 11, p. 1902.) Preliminary circuit details and oscillograph waveforms are presented to illustrate operation with the diode biased in the negative-resistance region but quenched in the positive-resistance region.

621.382.23: 621.391.822 **727**

Noise Performance of Tunnel Diodes.—E. G. Nielsen. (*Proc. Inst. Radio Engrs*, Nov. 1960, Vol. 48, No. 11, pp. 1903–1904.) With thermal noise represented by a parasitic series resistance and shot noise by an equivalent conductance a theoretical expression for noise factor as a function of frequency is deduced.

621.382.23: 621.391.822.3 **728**

Theoretical Justification for Shot-Noise Smoothing in the Esaki Diode.—R. La Rosa & C. R. Wilhelmsen. (*Proc. Inst. Radio Engrs*, Nov. 1960, Vol. 48, No. 11, p. 1903.) With the probability of conduction electrons tunnelling across a thin junction assumed equal to 0·5 an expression is derived for mean-square noise current.

621.382.333 **729**

Characteristics of Germanium p-n Junction with Irregular Structure.—M. Tomono. (*J. phys. Soc. Japan*, July 1960, Vol. 15, No. 7, pp. 1223–1236.) Components of the current flowing into an imperfect emitter junction of irregular structure were studied. Explanations are given for I/V characteristics of the emitter differing greatly from the Shockley equation, the abnormally strong current dependence of the current amplification factor of the transistor, and the floating potential of the emitter.

621.382.333 **730**

The Frequency Response of Power Transistors in the L.F. Range and its Effect on the Gain of Transistor Output Stages.—L. Hermsdorf & J. Meinhardt. (*Nachr Tech.*, Feb. 1960, Vol. 10, No. 2, pp. 80–83.)

621.382.333: 621.318.57 **731**

Switching Transistors.—J. N. Barry. (*Electronic Technol.*, Dec. 1960, Vol. 37, No. 12, pp. 442–449.) Departures from the behaviour predicted by simple theory have been found and a modified equivalent circuit is suggested.

621..382.333 : 621.372.57 **732**

Application of the Theory of Noisy Quadripoles to Transistors at Low Frequencies.—J. Schubert. (*Telefunken-Röhre*, Jan. 1960, No. 33a, pp. 5–42.) The noise characteristics of a transistor in common-emitter configuration are calculated from the internal noise sources of Giacoletto's equivalent circuit and compared with measured values in the region of white noise. Flicker noise is also considered and optimum operating conditions for minimum noise figure are stated. The transistor noise figure is compared with that of a vacuum triode.

621.382.333 : 681.142 **733**

The Frequency Response of Junction Transistors in Electronic Computers.—G. Laskowski. (*NachrTech.*, Feb. 1960, Vol. 10, No. 2, pp. 68–72.) Simplified treatment of transistor and diode logic circuits for use in digital computers.

621.382.333.018.78 **734**

Harmonic Distortion Factor of Transistors.—S. Kawaguchi & M. Hirai. (*Rev. elect. Commun. Lab., Japan*, Jan./Feb. 1960, Vol. 8, Nos. 1/2, pp. 34–38.) An equation is derived for the second-harmonic distortion factor of an amplifier circuit at low frequencies. Variations of distortion factor with change of bias and frequency have been measured.

621.383 : 535.371.07 **735**

A Two-Colour-Input, Two-Colour-Output Image-Intensifier Panel.—F. H. Nicoll & A. Sussman. (*Proc. Inst. Radio Engrs*, Nov. 1960, Vol. 48, No. 11, pp. 1842–1846.) The design and construction of a solid-state unit which can be separately excited by visible or infrared images. The characteristics of the unit are given.

621.383.292.001.4 **736**

Investigations of the Local Characteristics of Photomultipliers.—P. Cachou. (*C. R. Acad. Sci., Paris*, 8th Feb. 1960, Vol. 250, No. 6, pp. 1004–1006.) A technique is described for studying the characteristics of photomultiplier tubes under normal working conditions. The tube is illuminated by a succession of very short light pulses from a flying-spot scanner.

621.385.032.213.13 **737**

The Conductivity of Oxide Cathodes: Part 8—Current-Dependent Matrix Dissociation.—G. H. Metson & E. Macartney. (*Proc. Instn elect. Engrs*, Part C, Sept. 1960, Vol. 107, No. 12, pp. 158–162.) A discussion of the dissociative action which accompanies the passage of a current through a Ba-Sr oxide matrix at 1020°K. Part 7: 2561 of 1960.

621.385.2 **738**

Transient Space-Charge Flow.—R. J. Lomax. (*J. Electronics Control*, Aug. 1960, Vol. 9, No. 2, pp. 127–140.) Numerical analysis of the flow of space charge under non-steady-state conditions in a parallel-plane diode, showing how a steady or quasi-steady state is established.

621.385.3 + 621.385.5 **739**

The Noise of Grid-Controlled Mixer Valves.—R. Cantz. (*Telefunken-Röhre*, Jan. 1960, No. 33a, pp. 63–104.) Application of the theory of noisy quadripoles (1695 of 1957) to the calculation of the total noise admittance and the noise figure of a mixer stage. Apparatus for the measurement of noise characteristics is described, and results obtained with it are discussed.

621.385.3 **740**

The Noise and Stability of a Non-neutralized Triode used as a High-Frequency Input Stage.—R. Sittner. (*Telefunken-Röhre*, Jan. 1960, No. 33a, pp. 147–206.) The advantages of non-neutralized over neutralized triodes in earthed-cathode input stages of television receivers are outlined. The investigation of the noise characteristics of the input stages is based on the theory of noisy quadripoles (1695 of 1957) and on experimental results. Normalized curves of noise figure and power gain are given, and the design of a cascode stage for operation at 200 Mc/s is detailed as an example.

621.385.5 **741**

The Noise Characteristic of a Pentode in the V.H.F. Range.—H. Bauer. (*Telefunken-Röhre*, Jan. 1960, No. 33a, pp. 43–62.) Calculations are based on the theory of noisy quadripoles considered earlier (1695 of 1957). The impedance of the cathode lead of the pentode is shown to have a great influence on the noise characteristics. By inserting a capacitance in this lead the minimum noise factor of the pentode can be made to be nearly as good as that of a triode.

621.385.5 : 621.374.3 **742**

How to Use the Secondary-Emission Pentode.—E. J. Martin, Jr. (*Electronics*, 7th Oct. 1960, Vol. 33, No. 41, pp. 60–63.) Applications in high-speed short-duration pulse techniques are illustrated.

621.385.6 **743**

Experiments on a Helix Buncher Tube.—N. T. Lavoo. (*J. Electronics Control*, July 1960, Vol. 9, No. 1, pp. 1–29.) Results of experimental measurements are given and compared with theory for a valve containing a klystron buncher, a short helix buncher, and a catcher gap.

621.385.6 : 621.375.9 : 621.372.44 **744**

Low-Noise Electron-Beam Amplifier.—J. Labus. (*Arch. elekt. Übertragung*, Feb. 1960, Vol. 14, No. 2, pp. 49–53.) Instead of a linearly polarized field, as in the quadrupole amplifier [361 of 1960 (Adler et al.)], circular polarization is proposed at the amplifier input. Amplification takes place even when the signal frequency exceeds the cyclotron frequency. The introduction of delay in the output line enables the amplifier to be used as a frequency converter.

621.385.6 : 621.375.9 : 621.372.44 **745**

New Microwave Tube Devices 'Fawshmotron' using the Fast Electron Wave.—Y. Matsuo. (*Proc. Inst. Radio Engrs*, Nov. 1960, Vol. 48, No. 11, p. 1908.) A brief description is given of proposed quadrupole amplifier, oscillator, and backward-wave oscillator systems.

621.385.623 : 621.316.726 **746**

Transistorized Lock-In for Klystron Automatic Frequency Control.—A. J. George & D. T. Teaney. (*Rev. sci. Instrum.*, Sept. 1960, Vol. 31, No. 9, pp. 997–998.) Circuit details are given of a phase detector and d.c. amplifier using low-drain transistors and batteries, which provides ± 15 V in series with the klystron reflector.

621.385.623.5 **747**

Noise Figures of Reflex-Klystron Amplifiers.—K. Ishii. (*Trans. Inst. Radio Engrs*, May 1960, Vol. MTT-8, No. 3, pp. 291–294. Abstract, *Proc. Inst. Radio Engrs*, Aug. 1960, Vol. 48, No. 8, p. 1515.)

621.385.623.5.072.6 **748**

Frequency Stabilization of Klystrons.—M. J. A. Smith. (*J. sci. Instrum.*, Oct. 1960, Vol. 37, No. 10, pp. 398–399.) Outline of a method which has advantages over existing techniques.

621.385.623.5.072.6 **749**

Transistorized Frequency Stabilization for Reflex Klystrons used in Magnetic Resonance.—P. Jung. (*J. sci. Instrum.*, Oct. 1960, Vol. 37, No. 10, pp. 372–374.) A fully transistorized stabilizer in which the effect of ripple and drift of the power supply is reduced by a factor of 1 000.

621.385.63 **750**

Electron Sheet Beam Focusing with Tape Ladder Lines.—W. E. Waters. (*J. appl. Phys.*, Oct. 1960, Vol. 31, No. 10, pp. 1814–1820.) Laplace's equation is solved approximately, to obtain the plasma frequency, beam stiffness and average beam potential for a sheet electron beam. A numerical example is given for a typical system.

621.385.63 **751**

Tapering Travelling-Wave Tubes.—G. M. Clarke. (*J. Electronics Control*, Aug. 1960, Vol. 9, No. 2, pp. 141–146.) A simplified analysis of the performance of a tapered travelling-wave valve. Results of more accurate calculations are indicated.

621.385.63 : 621.372.823 **752**

Interaction of Electrons with the H_{01}-Wave Field in a Circular Waveguide.—I. A. Gilinskiĭ. (*Dokl. Ak. Nauk S.S.S.R.*, 11th Oct. 1960, Vol. 134, No. 5, pp. 1055–1057.) Mathematical analysis of the interaction of an electron beam with the field of non-retarded mm waves.

621.385.632 **753**

A Small-R.F.-Signal Theory for an Electrostatically Focused Travelling-Wave Tube.—W. W. Siekanowicz. (*Proc. Inst. Radio Engrs*, Nov. 1960, Vol. 48, No. 11, pp. 1888–1901.) Using the Llewellyn-Peterson equations with correction factors derived by Pierce (2284 of 1947), consideration is given to the effect on the gain of large periodic variations of d.c. electron velocity. Comparison is made with measurements performed on an experimental system. 61 references.

621.385.632 : 621.376.4 **754**

Phase Modulation of T.W. Tubes.—R. H. Wadie, M. T. Stockford & M. Hutchinson. (*Electronic Technol.*, Dec. 1960, Vol. 37, No. 12, pp. 466–474.) The modulation products of a low-noise X-band

travelling-wave valve have been studied when modulated by waveforms of variable amplitude at recurrence frequencies of $\frac{1}{2}$ Mc/s and 1–10 kc/s.

621.385.632.12 **755**

Investigation of Helix Anisotropic-Dielectric and Helix Ribbed-Structure Slow-Wave Systems: Part 1.—V. P. Shestopalov & V. A. Slyusarskiĭ. (*Zh. tekh. Fiz.*, Nov. 1959, Vol. 29, No. 11, pp. 1317–1329.) Derivation of dispersion equations for a helix located in an anisotropic dielectric and determination of the distribution of power flux. The limiting case for transition to a helix/ribbed-structure is considered and the possibility of using a helix with a periodic variation in a travelling-wave valve is examined.

621.385.633 : 538.569.4 **756**

The Cyclotron-Resonance Backward-Wave Oscillator.—K. K. Chow & R. H. Pantell. (*Proc. Inst. Radio Engrs*, Nov. 1960, Vol. 48, No. 11, pp. 1865–1870.) The principle of cyclotron resonance interaction is applied to the construction of a backward-wave oscillator which requires no slow-wave circuit. Operation in the mm-wave band enables powers up to 15 W to be obtained, and the unit tunes over a 2 : 1 frequency band.

621.385.633 : 621.372.22 **757**

Investigations on Inhomogeneous Delay Lines of Periodic Structure.—H. Wehrig. (*Nachrichtentech. Z.*, Feb. 1960, Vol. 13, No. 2, pp. 71–81.) Measurements of dispersion and field strength were made on various types of three-dimensional grid structure whose suitability for use in backward-wave oscillators is discussed.

621.385.64 : 621.376.23.029.63 **758**

Microwave Oscillation and Detection by a Smooth-Anode Coaxial Magnetron.—R. M. Hill & F. A. Olson. (*Proc. Inst. Radio Engrs*, Nov. 1960, Vol. 48, No. 11, pp. 1906–1907.) Experiment confirms the theoretical analysis of Pease (1546 of 1960) which relates oscillator frequency to free-electron cyclotron frequency. Interaction with external sources is found to give a change in anode current proportional to the square root of signal power.

621.385.83 : 537.312.54 **759**

The Generation of X Rays in Valves.—W. Reusse. (*Nachrichtentech. Z.*, Feb. 1960, Vol. 13, No. 2, pp. 53–57.) The process of X-ray generation in c.r. tubes and electron microscopes, and the resulting radiation hazards and their prevention are considered.

621.385.832 **760**

General Investigation of Image Transformations on the Screen of Cathode-Ray Tubes caused by Constant Deflection Fields.—G. G. Gassmann. (*Arch. elekt. Übertragung*, Feb. 1960, Vol. 14, No. 2, pp. 71–76.) On the basis of calculations the possibility is considered of designing special c.r. tubes giving displays with arbitrary curvilinear orthogonal or skew coordinates.

621.387 : 621.362 **761**

Construction of a Thermionic Energy Converter.—Block, Corregan, Eastman, Fendley, Hernqvist & Hills. (See 707.)

621.387 : 621.391.822.029.64 : 621.317.7 **762**

Noise Generators for Centimetre Waves.—Saier. (See 670.)

621.387.032.212 **763**

The Influence of the Rolling Texture on the Electron Emission of Cold Cathodes of Pure Metal.—G. Part. (*Z. angew. Phys.*, March 1960, Vol. 12, No. 3, pp. 117–120.) A simple relation is established between the texture of polycrystalline Mo sheet and its cathodic properties in gas-discharge tubes.

MISCELLANEOUS

538.569.2.047 + 621.365.92 **764**

Industrial, Biological and Medical Aspects of Microwave Radiation.—A. F. Harvey. (*Proc. Instn elect. Engrs*, Part B, Nov. 1960, Vol. 107, No. 36, pp. 557–566.) 108 references.

621.3.049.7 : 621.382 **765**

A Categorization of the Solid-State Device Aspects of Microsystems Electronics.—I. A. Lesk, N. Holonyak, Jr, R. W. Aldrich, J. W. Brouillette & S. S. Ghandi. (*Proc. Inst. Radio Engrs*, Nov. 1960, Vol. 48, No. 11, pp. 1933–1941.) 59 references.

Abstracts and References

COMPILED BY THE RADIO RESEARCH ORGANIZATION OF THE DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH AND PUBLISHED BY ARRANGEMENT WITH THAT DEPARTMENT

The abstracts are classified in accordance with the Universal Decimal Classification. They are arranged within broad subject sections in the order of the U.D.C. numbers, except that notices of book reviews are placed at the ends of the sections. U.D.C. numbers marked with a dagger (†) must be regarded as provisional. The abbreviations of journal titles conform generally with the style of the World List of Scientific Periodicals. An Author and Subject Index to the abstracts is published annually; it includes a list of journals abstracted, the abbreviations of their titles and their publishers' addresses. Copies of articles or journals referred to are not available from Electronic Technology. *Application must be made to the individual publishers concerned.*

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ACOUSTICS AND AUDIO FREQUENCIES

534.22.14: 546.212 **766**

Determination of the Velocity of Sound in Distilled Water.—R. Brooks. (*J. acoust. Soc. Amer.*, Nov. 1960, Vol. 32, No. 11, pp. 1422–1425.) The velocity of sound has been determined to an accuracy of ± 1 ft/sec from measurements in the range 22–25 °C of the time of transit along two sound paths of different lengths between the crystal faces of two $BaTiO_3$ transducers. Results are in close agreement with those of Greenspan & Tschiegg (1296 of 1958).

534.26-8 **767**

Empirical Study of the Effect of Diffraction on Velocity of Propagation of High-Frequency Ultrasonic Waves.—H. J. McSkimin. (*J. acoust. Soc. Amer.*, Nov. 1960, Vol. 32, No. 11, pp. 1401–1404.) The effect of diffraction in increasing the velocity of propagation over the plane-wave value is determined experimentally by phase comparison of reflected longitudinal waves in fused silica blocks.

534.283-8: 538.6 **768**

Ultrasonic Absorption in Metals in a Magnetic Field: Part 2.—V. L. Gurevich. (*Zh. eksp. teor. Fiz.*, Dec. 1959, Vol. 37, No. 6 (12), pp. 1680–1691.) The absorption coefficient is calculated by solving simultaneously the kinetic and Maxwell's equations. Two types of absorption mechanism are identified: (*a*) deformation, and (*b*) induction. Part 1: 1843 of 1960.

534.41-8: 537.32 **769**

Thermoelectric Microphone for Modulated Ultrasonic Waves.—R. A. Hanel. (*J. acoust. Soc. Amer.*, Nov. 1960, Vol. 32, No. 11, pp. 1436–1442.) Description of a small omnidirectional drift-free microphone for measuring the periodic change of temperature generated by an a.m. sound wave. Temperature changes of the order of 3×10^{-4} °C have been detected by a constantan-manganin couple and recorded by means of a narrow-band amplifier tuned to the modulation frequency.

534.614 **770**

The Effect of Attenuation on the Acoustic Resonant Frequencies of Gases in Tubes.—H. J. Wintle. (*Proc. phys. Soc.*, 1st Nov. 1960, Vol. 76, No. 491, pp. 772–775.) "The change in the resonant frequencies of a sound tube due to the dependence of attenuation on frequency is worked out for two cases of practical interest. The effect on measured values of the velocity of sound is shown to be significant in accurate work."

534.614-8: 621.3.018.75 **771**

Precision Ultrasonic Velocity Measurements.—R. L. Forgacs. (*Electronics*, 18th Nov. 1960, Vol. 33, No. 47, pp. 98–100.) Circuit details are given of an improved 'sing-around' system incorporating modifications suggested by Myers et al. (249 of 1959).

AERIALS AND TRANSMISSION LINES

621.315.212: 621.391.822 **772**

Noise Generation by Coaxial Cables when Subjected to Vibration.—R. D. Hyde. (*Electronic Engng*, Dec. 1960, Vol. 32, No. 394, pp. 770–771.) A brief summary of factors governing noise generation, and two suggested techniques for minimizing it.

621.315.212.018.75 **773**

The High-Frequency Properties of a Coaxial Cable and the Distortion of Fast Pulses.—G. Fiheraru. (*Nuovo Cim.*, 1960, Vol. 15, Supplement No. 2, pp. 254–263. In English.) The h.f. properties of a coaxial cable are discussed theoretically and an accurate method is described for determining the delay.

621.372.2: 621.372.54 **774**

Two-Path Transmission-Line Network.—C. S. Gledhill. (*Electronic Technol.*, Jan. 1961, Vol. 38, No. 1, pp. 22–26.) An analysis is given in terms of the normalized terminating impedance, and is applied to the design of a two-path network for impedance transformation and for a rejection filter.

621.372.821: 621.396.677.7 **775**

Printed-Circuit Waveguides and their Application to Microwave Aerials.—J. C. Parr. (*Brit. Commun. Electronics*, Jan. 1961, Vol. 8, No. 1, pp. 20–24.) The principles of construction of open-line and closed-line systems are given. A comparison analysis illustrates the superior performance of high-Q closed lines.

621.372.824: 537.56 **776**

On Microwave Propagation in a Plasma-Filled Coaxial Line.—B. Enander. (*Ericsson Tech.*, 1960, Vol. 16, No. 1, pp. 59–75.) Experimental results show that a signal passing through a glow-discharge is attenuated if the signal frequency lies within a certain band, the lower limit of which is

the gyromagnetic frequency. The attenuation is caused by absorption of the signal in the discharge.

621.372.852.2 : 621.317.77.088 777

Error Analysis of a Standard Microwave Phase Shifter.—G. E. Schafer & R. W. Beatty. (*J. Res. nat. Bur. Stand.*, Oct.–Dec. 1960, Vol. 64C, No. 4, pp. 261–265.) The standard phase shifter proposed by Magid (*Trans. Inst. Radio Engrs*, Dec. 1958, Vol. I-7, Nos. 3 & 4, pp. 321–331) is a tunable three-arm waveguide junction with an adjustable short-circuit. Graphs are given for use in estimating the limits of tuning error from observations of amplitude changes during tuning.

621.372.852.323 778

Applications for Ferrite Resonance Isolators.—E. F. Schelisch. (*Point to Point Telecommun.*, June 1960, Vol. 4, No. 3, pp. 4–10.) Applications at frequencies above 2 Gc/s and with isolation factors of the order of 20 dB, with 10% bandwidth, are briefly described.

621.396.67.08 : 621.317.7 : 621.373.42.029.5 779

A Portable H.F. Spectrum Generator for Antenna Calibration.—Burtnyk. (See 1002.)

621.396.67.09 780

Transient Electromagnetic Waves around a Cylindrical Transmitting Antenna.—P. O. Brundell. (*Ericsson Tech.*, 1960, Vol. 16, No. 1, pp. 137–162.) The e.m. field generated by a cylindrical radiator fed by an arbitrary nonsinusoidal voltage is determined theoretically. The representation of the field in terms of an infinite set of elementary travelling waves reflected from the ends of the radiator is discussed with reference to Hallén's theory.

621.396.677.029.6 : 621.396.96 : 535.164.32 781

Aerial Calibration by Solar Noise using Polar Display.—M. H. Cullin. (*Marconi Rev.*, 1st Quarter 1960, Vol. 23, No. 136, pp. 33–48.) Experimental equipment for the measurement of aerial polar diagrams using solar noise is described and some results are given. See also 897 and 898 below.

621.396.679.8 : 621.397.62 782

Television Simulcasts: a Survey.—R. J. Slaughter. (*J. Telev. Soc.*, July–Sept. 1960, Vol. 9, No. 7, pp. 289–295.)

621.396.677.8 783

Nonresonant End-Fed Aerials.—V. L. Talrose. (*Electron. Technol.*, Jan. 1961, Vol. 38, No. 1, pp. 13–15.) The directions of maximum radiation for aerials of different length are obtained by a graphical method.

621.396.677.833.2 784

Screened Wide-Band Helical Aerial as Primary Aerial for Paraboloidal Reflectors in the 600-Mc/s Range.—M. Krank. (*Telefunken Ztg.*, March 1960, Vol. 33, No. 127, pp. 46–57. English summary, p. 74.) The design is described of a screened helical aerial for operation in the frequency range 625–960 Mc/s and particularly suitable for large-aperture reflectors. Performance data are given for reflectors of 1·75 and 3 m diameter; results are better than those achieved with ordinary helical aerials.

AUTOMATIC COMPUTERS

681.142 785

Development of Japanese Digital Computers.—S. Takahashi. (*Computer J.*, Oct. 1959, Vol. 2, No. 3, pp. 122–129.) Parametron and transistor circuit techniques widely used in Japanese computers are described and the general characteristics of 20 types of computer are tabulated.

681.142 : 621-526 786

A V.I.F. Function Generator.—J. Whitlow. (*Electronic Engng*, Dec. 1960, Vol. 32, No. 394, pp. 750–752.) An electromechanical device producing a readily variable function is described.

CIRCUITS AND CIRCUIT ELEMENTS

621.3.049.7 787

Microminiaturization.—M. M. Ferrigni & N. Lindgren. (*Electronics*, 25th Nov. 1960, Vol. 33, No. 48, pp. 77–106.) Illustrated review of current achievements.

621.372.5 788

Calculation of the Parameters of a Quadripole by means of Signal Flow Graphs.—E. Casagrasi & V. Chow. (*Onde élect.*, Sept. 1960, Vol. 40, No. 402, pp. 617–625.)

621.372.5 789

A Modified Synthesis Procedure for Two-Terminal-Pair Networks.—S. S. Haro. (*Marconi Rev.*, 2nd Quarter 1960, Vol. 23, No. 137, pp. 59–66.) A general theorem given previously (2146 of 1959) is extended to a particular case of a network with one pair of terminals open-circuited.

621.372.54 790

Design of Optimum Filters.—S. Darlington. (*Bell Telephone Engrs*, July–Aug. 1960, Vol. 6, No. 5, pp. 217–222.) The design of low-pass filters using easily computed rational functions instead of elliptic functions permits more accurate location of the poles of the transfer function when the number of poles exceeds four, and computation is less laborious.

621.373.8 791

General Principles of Polyphase Resonator-Type Oscillators.—T. Takagi & K. Mano. (*Sci. Rep. Res. Inst. Tohoku Univ., Series B*, 1960, Vol. 11, Nos. 5-6, pp. 279–290.)

621.373.4 : 621.376.32 : 621-526 792

Synchronization of Frequency-Modulated Free-Running Oscillators Investigated by Servomechanism Methods.—H. H. Ernyei. (*Onde élect.*, Sept. 1960, Vol. 40, No. 402, pp. 602–616.) Application of a servo system to the control of a free-running oscillator. A method is described for determining the frequency response of the closed loop from measurements of open-loop characteristics. Quadripole correctors for improving the response will also widen the frequency range over which control may be exercised. See also 3029 of 1960 (Freeman).

621.373.421.11 793

Pass-Band and Selective A.F. Amplification of a H.F. Oscillator.—H. Hasenjäger. (*Onde élect.*, Dec. 1958, Vol. 38, No. 381, pp. 838–841.) The bandwidth of a h.f. oscillator has been investigated theoretically and experimentally by studying the behaviour of the oscillator as a selective a.f. amplifier.

621.373.431.1 : 621.382.3 794

Analysis of a Semiconductor Multivibrator with Emitter Capacitance.—E. F. Dorenkin. (*Zh. tekh. sch. Zic., Radiotekhn.*, Jan.–Feb. 1960, Vol. 3, No. 1, pp. 106–111.) An analysis of an emitter-coupled transistor multivibrator showing the effect of emitter capacitance in increasing the thermal stability of the pulse-duration parameters.

621.374.3 : 621.317.8 795

Fast Transistorized Time-to-Pulse-Height Converter.—G. Galligan & D. H. Lipman. (*Rev. sci. Instrum.*, Nov. 1960, Vol. 31, No. 11, pp. 1209–1216.) A converter of simple design is described having a 0·15-ns resolute and giving a resolution of 10^{-9} s using conventional scintillation counters. It was used to analyse particle beams by time-of-flight measurements.

621.374.32 : 621.397 796

A Reversible Sequence Circuit.—A. J. Oxley. (*Electron. Engng*, Jan. 1960, Vol. 32, No. 384, pp. 746–748.) A description of the unit with discussion of its limitations.

621.376.23 797

Programmable Functional Frequency Converter.—S. Phillips & O. Lamplen. (*Proc. Inst. Radio Engrs*, Dec. 1960, Vol. 48, No. 12, pp. 1980–1987.) A self-starting regenerative frequency divider circuit is described which has the advantages of simplicity and of inherent stability over a wide range of frequencies. The approximate analysis given which shows the dependence of performance on circuit characteristics and transistor input impedance.

621.375.2.029 798

Simple Logarithmic D.C. Amplifier.—L. V. Eno & M. E. Parker. (*Rev. sci. Instrum.*, Nov. 1960, Vol. 31, No. 11, pp. 1222–1225.) A simple double-triode amplifier is described. It has an accuracy within 1% for input voltages from 1 to 100 V and is easily adjusted for different value-decade systems.

621.375.29 799

The Boomerang Amplifier.—M. Tuteur. (*Electron. Technol.*, Jan. 1961, Vol. 38, No. 1, pp. 27–31.) An analysis of a RC-

coupled pentode amplifier with the anode decoupling capacitor returned to the cathode of a cathode follower. The effects of the coupling and decoupling capacitors on the low-frequency response characteristics are calculated.

621.375.3 **650**

Analysis of Half-Wave Magnetic Amplifier Circuits with A.C. Bias Voltage.—T. Kikuchi. (*Sci. Rep. Res. Inst. Tohoku Univ., Series B*, 1960, Vol. 11, Nos. 3/4, pp. 133–134.) Detailed analysis with special reference to the elimination of the rectifier from the control circuit of Ramey's half-wave magnetic amplifier (see e.g. 3307 of 1953).

621.375.432 **651**

A Nonlinear Effect in Transistor Amplifiers with Feedback.—J. Granowski. (*C. R. Acad. Sci., Paris*, 1st Feb. 1960, Vol. 250, No. 5, pp. 822–828.) The nonlinear effect described in an earlier paper (4130 of 1960) is analyzed. It is attributed to variations of carrier transit-time with transistor collector voltage.

621.375.9: 538.569.4 **652**

Use of Slow Molecules in Molecular Generators.—N. G. Basov & A. N. Oraevskii. (*Zh. eksp. teor. Fiz.*, Oct. 1959, Vol. 37, No. 4 (10), pp. 1069–1071.) Methods of improving the absolute frequency stability of a beam-type maser are considered, based on the use of molecular beams with mean velocities much less than the thermal velocity at room temperature. Three techniques are described: (a) removal of high-velocity molecules from the beam; (b) separation of the molecules by an external field; (c) reduction of the temperature of the molecular beam.

621.375.9: 538.569.4 **653**

Spurious Applications of Solid-State Masers.—J. W. Meyer. (*Electronics*, 9th Dec. 1960, Vol. 33, No. 50, pp. 71–73.) Progress in solid-state maser techniques is surveyed. Operating principles and circuit design are outlined.

621.375.9: 538.569.4 **654**

The Optimum Line Width for a Reflection Cavity Maser.—G. J. Troup. (*Brit. J. Appl. Phys.*, Sept. 1960, Vol. 11, No. 9, pp. 415–416.) Extension of previous work (3861 of 1960) to take into account spurious reflection at the cavity input.

621.375.9: 546.289.6 **655**

Microwaveably Tunable Paramagnetic Wave Maser at 9 and 9 Gmc/s.—A. Gilbert, F. R. Isaacs & J. G. Smith. (*Proc. Inst. Radio Engrs*, Dec. 1960, Vol. 48, No. 12, pp. 2025–2026.) Tuning ranges of 250 Mc/s and greater have been obtained by varying only the applied magnetic field and the pump frequency. Test data are given.

621.375.9: 621.372.44 **656**

Coupled-Cavity Travelling-Wave Parametric Amplifiers: Part 1—Theory.—M. R. Currie & R. W. Gould. (*Proc. Inst. Radio Engrs*, Dec. 1960, Vol. 48, No. 12, pp. 1960–1973.) Detailed information is given on operating characteristics of a travelling-wave circuit consisting of a chain of inductively coupled cavities loaded by diodes in the capacitive region. Calculations show that unilateral gains of 12–15 dB over relatively wide bandwidths are attainable with 4–6 diodes.

621.375.9: 621.372.44 **657**

Coupled-Cavity Travelling-Wave Parametric Amplifiers: Part 2—Experiments.—K. P. Grabowski & R. D. Weglein. (*Proc. Inst. Radio Engrs*, Dec. 1960, Vol. 48, No. 12, pp. 1973–1987.) Gain-bandwidth products of 2 Gc/s with a 330-Mc/s bandwidth have been obtained at 9-band frequencies using commercially available diodes. Noise temperatures of 130 °K have been measured. Methods for achieving short-circuit stability are investigated. These include the use of ferrite-loaded coupling irises and of upper-frequency pass bands.

621.375.9: 621.372.44 **658**

Gain of a Travelling-Wave Parametric Amplifier using Nonlinear Loss Capacitance.—W. Jasinski. (*Proc. Inst. Radio Engrs*, Dec. 1960, Vol. 48, No. 12, pp. 2010–2018.) An analysis of a travelling-wave parametric amplifier, considering resistance-biased diodes as lossy capacitors.

621.375.9: 621.372.44 **659**

Inputs to Wide-Band Parametric Travelling-Wave Amplifiers.—B. F. Hasrick. (*Decca Tech.*, 1960, Vol. 31, No. 1, pp. 77–101.) Methods are described for calculating amplification, bandwidth, phase conditions and noise figure.

621.375.9: 621.372.44: 621.372.632 **660**

Gain Optimization in Low-Frequency Parametric Upconverters by Multi-Mode Operation.—S. S. Kamal & M. Subramanian. (*Proc. Inst. Radio Engrs*, Dec. 1960, Vol. 48, No. 12, pp. 2039–2041.) A method is proposed for optimizing the gain of an upconverter using more than one variable-capacitance diode at the same pump. Results of a three-diode analysis made with two diodes are given.

621.375.9: 621.372.44: 621.391.822 **661**

Idler Noise in Parametric Amplifiers.—G. Heffner. (*Proc. Inst. Radio Engrs*, Dec. 1960, Vol. 48, No. 12, pp. 2041–2043.)

621.396.21: 621.372.8 **662**

Quadrature Amplifier at 5, 10 and 20 Gc/s.—R. D. Chamberlain. (*Proc. Inst. Radio Engrs*, May 1960, Vol. 48, No. 12, pp. 2042–2043.) Quadrature amplifiers with 40–60 dB of gain and 0.5 Gc/s and 30–40 dB at 10 Gc/s have been obtained with the Varian model 10 re-entrant cavity which has been described earlier (3558 of January). (Varian Associates & Bomac.)

[redacted]

535.13 **663**

Extension of Uniqueness for the Solutions of Maxwell's Equations.—P. Poincelot. (*Ann. Télécomm.*, March/April 1960, Vol. 15, Nos. 3/4, pp. 77–83.) See 3628 of 1959.

537.122 **664**

The Dirac Electron in Rectilinear Fields.—D. V. A. S. Amarasekera. (*Ceylon J. Sci., phys. Sci.*, June 1958, Vol. 1, No. 1, pp. 37–40.) Dirac's equations for an electron in a rectilinear field are first reduced to a single equation of simple form, suitable for the solution of problems. An explicit solution is then obtained for an electron in a constant electric field.

537.311.1 **665**

Variational Treatment of Wave Electrons in Singular Crystals.—I. Adawi. (*Phys. Rev.*, 1st Oct. 1960, Vol. 120, No. 1, pp. 118–127.) Deviations from Ohm's law in singular crystals are treated by the variational method for the case of weak fields. The second-order term in the electrical conductivity is calculated.

537.311.3 **666**

Effect of Surface Inhomogeneities on Electrical and Galvanomagnetic Measurements.—C. Herring. (*J. appl. Phys.*, Nov. 1960, Vol. 31, No. 11, pp. 1939–1953.) A theoretical treatment is given in which the scale of inhomogeneities is supposed small compared with the specimen size but large compared with the mean free path and Debye length. Comparison with experimental results shows the derived formulae to be valid for usable thicknesses.

537.311.33 **667**

The Validity of the Concept of Specific Surface Resistance and its Measurement.—R. Lucas & P. Pulfrey. (*J. Sci. Instr.*, Dec., 1st Feb. 1960, Vol. 37, No. 1, pp. 348–349.) Discussion of earlier work by Lucas (3532 of 1959) to show that the criterion for surface conduction is independent of the electrode system concerned. The influence of the configuration on measured resistance is considered.

537.311.33: 535.215 **668**

Steady-State Distribution Function in Glow Discharge Gases.—H. C. Hayes. (*Phys. Rev.*, 1st Oct. 1960, Vol. 120, No. 1, pp. 35–37.) The above assumption for distribution function of generally followed and not appropriate. For a simple model [illegible] the distribution is found from the Boltzmann equation and applied to experimental values in the hydrogen glow.

537.311.33: 535.215 **669**

On the Possible Influence of Electron Excitation on the Conductivity of Metals.—G. W. Rendell. (*Appl. sci. Res., Sect. B*, 1958, Vol. 7, No. 4, pp. 273–280.) Discussion of the work by Brodeur & Koenig (3529 of 1958) on the influence of electron excitation on the emission factor of metals in the ultraviolet region.

537.525 **670**

Transient, Localized, Pulsed Microwave Discharge in Air.—C. W. Hamilton. (*Rev. Sci. Instr.*, Oct. 1960, Vol. 31, No. 10, pp. 1060–1066.) Details are given of a small localized discharge obtained in low-pressure air, using a pulsed X-band radar transmitter as the microwave source.

537.533.7: 539.23 **821**

Transmission of Slow Electrons through Thin Films.—O. Klemperer & A. Thetford: F. Lenz. (*Proc. phys. Soc.*, 1st Nov. 1960, Vol. 76, No. 491, pp. 705–720.)

537.56 **822**

Investigation of a Plasma Column Continuously Fed and Subjected to a Magnetic Field: First-Order Approximations for the Diffusion Velocities; Manifestation of a Frontier Zone.—J. M. Dolique & M. Y. Bernard. (*C. R. Acad. Sci., Paris*, 22nd Feb. 1960, Vol. 250, No. 8, pp. 1458–1459.) For preceding note see 496 of February (Dolique).

537.56 **823**

Free-Path Formulae for the Coefficient of Diffusion D and Velocity of Drift W of Ions and Electrons in Gases.—L. G. H. Huxley. (*Aust. J. Phys.*, Sept. 1960, Vol. 13, No. 3, pp. 578–583.) See also 94 of 1958.

537.56 **824**

Ion Resonance in a Multicomponent Plasma.—S. J. Buchsbaum. (*Phys. Rev. Lett.*, 1st Dec. 1960, Vol. 5, No. 11, pp. 495–497.) Interactions between different types of ion produce additional resonances.

537.56: 538.56 **825**

Oscillations of an Electron - Ion Plasma.—L. M. Kovrizhnykh. (*Zh. eksp. teor. Fiz.*, Dec. 1959, Vol. 37, No. 6 (12), pp. 1692–1696.) Investigation of the spectrum of longitudinal oscillations for the case of low temperature (Fermi distribution) and high temperature (Maxwell distribution). For low values of the wave vector the dispersion equation has two branches, corresponding to optical and acoustic modes.

538.114 **826**

Direct Exchange in Ferromagnets.—R. Stuart & W. Marshall. (*Phys. Rev.*, 15th Oct. 1960, Vol. 120, No. 2, pp. 353–357.) Evaluation for all internuclear spacings of the direct-exchange integral occurring in the Heisenberg theory of ferromagnetism leads to the conclusion that direct exchange is not responsible for ferromagnetism in ferromagnetic metals.

538.114 **827**

Collective Excitations of Electrons in Degenerate Bands: Part 1—Spin Waves in Stoner's Model of Ferromagnetism.—T. Izuyama. (*Progr. theor. Phys.*, June 1960, Vol. 23, No. 6, pp. 969–983.) Spin waves in the collective electron model of ferromagnetism are derived.

538.114 **828**

Anisotropic Superexchange Interaction and Weak Ferromagnetism.—T. Moriya. (*Phys. Rev.*, 1st Oct. 1960, Vol. 120, No. 1, pp. 91–98.) A theory is developed by extending the Anderson theory of superexchange (*ibid.*, 1st July 1959, Vol. 115, No. 1, pp. 2–13) to include spin-orbit coupling.

538.3 **829**

Determining the Dielectric Permittivity and Magnetic Permeability Tensors of a Medium.—G. S. Krinchik & M. V. Chetkin. (*Zh. eksp. teor. Fiz.*, June 1959, Vol. 36, No. 6, pp. 1924–1925.) An analytical note on the separation of gyroelectric and gyromagnetic effects.

538.561: 537.533.7 **830**

Transition Radiation in a Waveguide.—K. A. Barsukov. (*Zh. eksp. teor. Fiz.*, Oct. 1959, Vol. 37, No. 4 (10), pp. 1106–1109.) Investigation of the radiation which arises in a waveguide by the passage of a charged particle through the boundary between two media. At ultrarelativistic charge velocities the radiation is mainly in the forward direction and its magnitude is proportional to the particle energy. Formulae for the total energy of the radiation and its spectral distribution are derived.

538.566 **831**

Some Absorbent Materials at U.H.F.—H. G. Stubbs & J. Peyssou. (*Onde élect.*, Dec. 1958, Vol. 38, No. 381, pp. 809–818.) The characteristics of two types of absorbent material are described: (*a*) a plastic or rubber sheet impregnated with carbon powder, applicable over a wide band of frequencies, and (*b*) a similar material $\lambda/4$ thick, impregnated with carbonyl-iron or carbon powder and backed with a thin metallic sheet, applicable over a narrow band.

538.566: 535.42 **832**

Contribution to the Study of Diffraction of Electromagnetic Waves by Spheres.—J. Mével. (*Ann. Phys., Paris*, March/April 1960, Vol. 5, Nos. 3/4, pp. 265–320.) A thesis, describing theoretical and experimental methods of obtaining the diffraction field of both a single sphere and a pair of spheres. For a report of experimental apparatus see 1393 of 1958.

538.566: 535.42 **833**

Diffraction of a Plane Electromagnetic Wave by Cylinders with Anisotropic Conductivity.—R. E. Kelly & A. Russek. (*Nuovo Cim.*, 16th May 1960, Vol. 16, No. 4, pp. 593–610. In English.)

538.566: 535.43 **834**

A Study of Surface Roughness and its Effect on the Back-Scattering Cross-Section of Spheres.—R. E. Hiatt, T. B. A. Senior & V. H. Weston. (*Proc. Inst. Radio Engrs*, Dec. 1960, Vol. 48, No. 12, pp. 2008–2016.) Experimental data obtained by measuring the back-scattering cross-section of a large rough sphere at three frequencies in the S, X and K bands, are presented. Even for a sphere whose depth of roughness is as large as $10^{-2}\lambda$, the measured change in cross-section is no more than 0·1 dB; this is in good agreement with the theoretical prediction.

538.569.4 **835**

Line Breadths in the Ammonia Spectrum.—J. A. Fulford. (*Nature, Lond.*, 24th Dec. 1960, Vol. 188, No. 4756, pp. 1097–1098.) Measurements have been made of the NH_3 inversion spectrum ($J=K$, 1 to 6). From the results a value of $25{\cdot}7 \pm 0{\cdot}2$ Mc/s per mm Hg at 27°C has been obtained.

538.569.4: 535.853 **836**

Line Structure in Paramagnetic Resonance and Direct Measurement of the Moments.—J. Hervé. (*Ann. Phys., Paris*, March/April, 1960, Vol. 5, Nos. 3/4, pp. 321–364.)

538.569.4: 535.853 **837**

The Influence of Modulation on the Recording of Resonance Phenomena.—F. Bruin & D. van Ladesteyn. (*Appl. sci. Res.*, 1958, Vol. B7, No. 4, pp. 270–274.) Curves based on the standard resonance curve, $y = 1/(1 + x^2)$ of a simple harmonic oscillator are given as an aid to the construction of spectrographs and the analysis of recorded spectra.

538.569.4: 538.221: 621.318.134 **838**

Nonlinear Effects of Crystalline Anisotropy on Ferrimagnetic Resonance.—P. Gottlieb. (*J. appl. Phys.*, Nov. 1960, Vol. 31, No. 11, pp. 2059–2062.) Analysis shows that the magnetic resonance frequency depends quadratically upon the precession amplitude, to lowest order; this can cause a foldover of the resonance line.

538.569.4: 538.222 **839**

Cross-Relaxation in Dilute Paramagnetic Systems.—A. Kiel. (*Phys. Rev.*, 1st Oct. 1960, Vol. 120, No. 1, pp. 137–140.)

538.652: 548.0 **840**

The Direction Dependence of Magnetostriction.—W. Döring & G. Simon. (*Ann. Phys., Lpz.*, 29th March 1960, Vol. 5, Nos. 7/8, pp. 373–387.) Tensor methods are used to describe the lattice distortion caused by magnetostriction. For similar calculations of the direction dependence of crystal energy see *ibid.*, 12th Dec. 1957, Vol. 1, Nos. 1–3, pp. 102–109 (Döring).

539.2 **841**

Proceedings of the International Congress on Many-Particle Problems.—(*Physica*, Dec. 1960, Vol. 26, Supplement, pp. S1–S217.) The text is given of invited papers read at a conference held in Utrecht, 13th–18th June 1960.

541.135: 621.319.4 **842**

Ion Size Effect and Mechanism of Electrolytic Rectification.—P. F. Schmidt, F. Huber & R. F. Schwarz. (*J. Phys. Chem. Solids*, Oct. 1960, Vol. 15, Nos. 3/4, pp. 270–290.) Previous theories of electrolytic rectification are shown to be inadequate. Extensive experimental work is presented which shows the importance of the size of the cation in solution, and the existence of an extremely thin (~250 Å) surface barrier of height about 1 V.

GEOPHYSICAL AND EXTRATERRESTRIAL PHENOMENA

523.14: 538.69 **843**

Note on the Transference of Angular Momentum within the Galaxy through the Agency of a Magnetic Field.—F. Hoyle & J. G. Ireland. (*Mon. Not. R. astr. Soc.*, 1960, Vol. 121, No. 3, pp. 253–259.) Extension of 2322 of 1960.

523.164: 523.45 **844**

Magnetic Field of Jupiter.—C. H. Barrow. (*Nature, Lond.*, 10th Dec. 1960, Vol. 188, No. 4754, pp. 924–925.) A review of theoretical and experimental evidence in support of the hypothesis of an ionosphere and magnetic field associated with Jupiter.

523.164: 551.594.5 **845**

The Correlation of Radio Source Scintillation in the Southern and Northern Hemispheres.—P. M. Brenan. (*J. atmos. terr. Phys.*, Dec. 1960, Vol. 19, Nos. 3/4, pp. 287–289.) Observations of radio source scintillation made simultaneously at Halley Bay and Jodrell Bank show a significant correlation. This is relevant to theories which associate high-latitude scintillation with auroral activity.

523.164: 551.594.5 **846**

The Magnetic Storm-Time Variation of Radio Star Scintillations and Auroral Radio Echoes.—C. D. Watkins. (*J. atmos. terr. Phys.*, Dec. 1960, Vol. 19, Nos. 3/4, pp. 289–292.) The variations of scintillation rate and auroral echo incidence, during periods following magnetic sudden commencements, resemble the variation of magnetic *K* index.

523.164.3 **847**

A 21-cm Determination of the Principal Plane of the Galaxy.—C. S. Gum, F. J. Kerr & G. Westerhout. (*Mon. Not. R. astr. Soc.*, 1960, Vol. 121, No. 2, pp. 132–149.) Data from the Leiden and Sydney surveys of the Milky Way have been used to determine the position of the plane of the neutral hydrogen layer which is found to be exceedingly flat over the galaxy within 7 kiloparsecs from the centre.

523.164.3 **848**

Radio Data Relevant to the Choice of a Galactic Coordinate System.—C. S. Gum & J. L. Pawsey. (*Mon. Not. R. astr. Soc.*, 1960, Vol. 121, No. 2, pp. 150–163.) Because of the large-scale association found between sources of the radio continuum and the distribution of the 21-cm-λ hydrogen-line radiation, the coordinate system may be defined by the HI principal plane and by a centre situated in Sagittarius A.

523.164.32: 523.745 **849**

Some Statistics of Solar Radio Bursts at Sunspot Maximum.—A. Maxwell, W. E. Howard, III, & G. Garmire. (*J. geophys. Res.*, Nov. 1960, Vol. 65, No. 11, pp. 3581–3588.) Bursts at 125 and 200 Mc/s are mainly of spectral type I and occur more frequently than bursts at 425 and 500 Mc/s which are of a greater intensity and of spectral type IV.

523.164.4 **850**

On the Identification of Extragalactic Radio Sources.—B. Y. Mills. (*Aust. J. Phys.*, Sept. 1960, Vol. 13, No. 3, pp. 550–577.) Radio data from Sydney and Cambridge have been compared with a catalogue of galaxies in a limited region of the sky. 46 possible identifications of r.f. sources with galaxies have been made, and 55 with clusters of galaxies.

523.165 **851**

Solar Modulation of Primary Cosmic Rays.—Y. Terashima. (*Progr. theor. Phys.*, June 1960, Vol. 23, No. 6, pp. 1138–1150.) The observed solar modulation of cosmic rays may be explained assuming the existence of two solar magnetic fields, one uniform and the other irregular, and two solar streams, one continuously ejected and the other produced by solar eruptions.

523.5 **852**

Southern-Hemisphere Meteor Shower Activity in July and August.—A. A. Weiss. (*Aust. J. Phys.*, Sept. 1960, Vol. 13, No. 3, pp. 522–531.) Observations for 1957–1959 are described and measurements of the radiant coordinates and echo rates for the δ-Aquarids and three other minor showers are summarized.

523.5 **853**

Meteor Height Distributions and the Fragmentation Hypothesis.—A. A. Weiss. (*Aust. J. Phys.*, Sept. 1960, Vol. 13, No. 3, pp. 532–549.) A comparative study of fragmentation amongst bright and faint meteors.

523.5 **854**

The Variation of Meteor Heights with Velocity and Magnitude.—J. S. Greenhow & J. E. Hall. (*Mon. Not. R. astr. Soc.*, 1960, Vol. 121, No. 2, pp. 174–182.) Radio echo observations of meteors of +6 magnitude show marked departures from the theoretically predicted heights. Possible explanations for these departures are considered. See 856 below.

523.5: 621.391.812.5 **855**

Volume Density of Radio Echoes from Meteor Trails.—Carrara, Checcacci & Ronchi. (See 1016.)

523.5: 621.396.96 **856**

The Importance of Initial Trail Radius on the Apparent Height and Number Distributions of Meteor Echoes.—J. S. Greenhow & J. E. Hall. (*Mon. Not. R. astr. Soc.*, 1960, Vol. 121, No. 2, pp. 183–196.) Fewer echoes from faint meteors of +6 magnitude are observed at 8 m λ than at 17 m λ. This effect is attributed to an attenuation in echo amplitude due to the large initial radii of the ionized trails.

523.5: 621.396.96 **857**

The Determination of the Incident Flux of Radio-Meteors.—T. R. Kaiser. (*Mon. Not. R. astr. Soc.*, 1960, Vol. 121, No. 3, pp. 284–298.) Simple formulae are derived which allow the incident flux of shower meteors to be deduced from the observed rate after allowing for the aerial characteristics and the geometry of reflection. The limitations of the method are discussed.

550.38: 523.75 **858**

The Interaction of the Terrestrial Magnetic Field with the Solar Corpuscular Radiation.—D. B. Beard. (*J. geophys. Res.*, Nov. 1960, Vol. 65, No. 11, pp. 3559–3568.) The shape of the cavity between the earth and a neutral solar stream differs by only 7–11% from a hemisphere of radius 7 earth radii on the incident side, but is elongated on the other side to a distance of the order of 100 earth radii. The cavity is indented at the polar latitudes where the current layer reverses.

550.385.4 **859**

The Cause of Magnetic Storms and Bays.—R. A. Duncan. (*J. geophys. Res.*, Nov. 1960, Vol. 65, No. 11, pp. 3589–3592.) Circulating currents set up around regions of proton and electron precipitation by the Hall effect are suggested as the cause of magnetic bays and storms.

550.385.4 **860**

Daytime Enhancement of the Amplitude of Geomagnetic Sudden Impulses in the Equatorial Region.—H. Maeda & M. Yamamoto. (*J. atmos. terr. Phys.*, Dec. 1960, Vol. 19, Nos. 3/4, pp. 284–287.) I.G.Y. data from equatorial stations provide some evidence that sudden impulses and sudden commencements are caused by similar mechanisms.

550.385.4: 539.16 **861**

Evidence of Quasi-perpendicular Propagation of Hydromagnetic Waves caused by Nuclear Explosions over Johnston Island.—H. Maeda & T. Ondoh. (*Nature, Lond.*, 17th Dec. 1960, Vol. 188, No. 4755, pp. 1018–1019.)

551.507.362.2 **862**

Verification of Earth's 'Pear Shape' Gravitational Harmonic.—C. J. Cohen & R. J. Anderle. (*Science*, 23rd Sept. 1960, Vol. 132, No. 3430, pp. 807–808.) Errors in the predictions of the orbit of the Transit 1B satellite (1960 γ) are accounted for by a third-order gravitational harmonic previously evaluated by O'Keefe et al. (2236 of 1959).

551.507.362.2: 523.165: 621.391.812.6 **863**

The Relation of the Satellite Ionization Phenomenon to the Radiation Belts.—J. D. Kraus & R. C. Higgy. (*Proc. Inst. Radio Engrs*, Dec. 1960, Vol. 48, No. 12, pp. 2027–2028). During March and April 1960 when telemetry transmissions from Explorer VII were monitored, the strongest enhancements of WWV signals received at Columbus, Ohio, occurred at times of peak counting rate aboard the satellite. Many of these events were accompanied by a partial or complete fade-out of the satellite signal. See also 1603 of 1960 (Kraus et al.).

551.507.362.2: 621.391.812.63 **864**

Some Characteristics of the Signal Received from 1958 δ2.—F. de Mendonca, O. G. Villard, Jr, & O. K. Garriot. (*Proc. Inst. Radio Engrs*, Dec. 1960, Vol. 48, No. 12, pp. 2028–2030.) The correlation between scintillation effects and the occurrence of spread-F is noted and skip-distance phenomena observed in ordinary- and extraordinary-wave propagation are discussed.

551.507.362.2: 621.396.96 **865**

Electromagnetic Waves and Satellites; Echoes from Ionized Trails of Satellites at High Frequency.—A. Flambard & M. Reyssat. (*Onde élect.*, Dec. 1958, Vol. 38, No. 381, pp. 830–837.) Ionized trails from 1957 β and 1958 ϵ were detected at 25 Mc/s using a pulsed 75-kW

transmitter and a receiver with 20-kc/s bandwidth. The results are discussed and the most favourable conditions for detecting echoes are examined.

551.510.535 **866**

On the Lunar Semidiurnal Variation of the D and F_2 Layers.—M. Bossolasco & A. Elena. (*Geofis. pura appl.*, May–Aug. 1960, Vol. 46, No. 2, pp. 167–172. In English.) The variations at Freiburg, Genoa and Léopoldville are compared with those obtained by other authors. Magnetic dip rather than geomagnetic latitude controls the variation in the F_2 layer. The amplitude of the f_0F_2 variation is plotted against magnetic dip.

551.510.535 **867**

On Some Disturbances in the E Region.—B. J. Robinson. (*J. atmos. terr. Phys.*, Dec. 1960, Vol. 19, Nos. 3/4, pp. 160–171.) A discussion of E-layer stratifications and complex phenomena observed on ionograms, in relation to computed electron $N(h)$ distributions. The passage of transient cusps on $h'(f)$ curves is found to be due to redistribution of E-layer ionization. Factors influencing the identification of E-layer penetration frequencies are discussed.

551.510.535 **868**

Investigation of the Transparency of the Ionospheric E_2 Layer.—K. Rawer. (*C. R. Acad. Sci., Paris*, 22nd Feb. 1960, Vol. 250, No. 8, pp. 1517–1519.) Report of an analysis of world-wide observations of diurnal changes in E_2. Results are discussed and tabulated in the form of an index called the 'degree of occultation' which is defined as the ratio f_b/f_t, where f_b is the blanketing frequency for reflections from the F layer, and f_t the highest frequency at which reflections from the E_2 layer are detected.

551.510.535 **869**

Mechanism of Ionization of the Sporadic-E Layer.—K. Bibl. (*Ann. Géophys.*, Jan.–March 1960, Vol. 16, No. 1, pp. 148–151.) Observations made using a technique based on that introduced by Nakata et al. (see e.g. 3297 of 1953 and 2937 of 1954) have shown that the height of E_2 varies in a systematic way during the lifetime of an E_2 event; if the intensity of ionization increases, the layer height decreases.

551.510.535 **870**

Horizontal Drift in the Ionosphere over Delhi.—S. N. Mitra, K. K. Vij & P. Dasgupta. (*J. atmos. terr. Phys.*, Dec. 1960, Vol. 19, Nos. 3/4, pp. 172–183.) The drift was measured using spaced-receiver techniques and both E- and F-layer reflections are analysed for the period April 1958–March 1959. Velocity histograms of the N-S and E-W components and plots of the seasonal variations in velocity and drift direction are given.

551.510.535 **871**

On the Observational Results of f_{min} at Yamagawa.—S. Ishikawa & K. Muramatsu. (*J. Radio Res. Labs., Japan*, July 1960, Vol. 7, No. 32, pp. 405–408.) Measurements of $f_{min}F$ and $f_{min}E$ made between August 1959 and February 1960 showed the presence of the winter anomaly in absorption at night.

551.510.535 **872**

On the Electron and Ion Density Distributions from the Lower up to the Uppermost Part of the F Region.—T. Yonezawa & H. Takahashi. (*J. Radio Res. Labs, Japan*, July 1960, Vol. 7, No. 32, pp. 335–378.) The thesis that the main ionizing radiations in the F region are the helium resonance lines at 304 and 584 Å and the Lyman continuum leads to the following results: (*a*) the calculated electron density distribution in the lower F region is in good agreement with experimental electron density profiles, (*b*) the observed and calculated relative abundances of the ions O^+, O_2^+ and NO^+ are not in good agreement unless their charge exchange reactions are assumed to be a few orders of magnitude slower than expected on simple theory, and (*c*) if a scale height gradient of 0·2 is assumed then the calculated and experimental electron densities are in agreement up to 100 km above the F-region maximum. See also 4222 of 1960 (Yonezawa).

551.510.535 **873**

On the F_2 Region of the Ionosphere.—S. Datta. (*Indian J. Phys.*, Feb. 1960, Vol. 34, No. 2, pp. 66–75.) A continuation of earlier work (800 of 1959) to include calculations of diurnal variations of production rate for March 1950, using the attachment-coefficient model suggested by Ratcliffe et al. (2724 of 1956). Results are compared with those for January 1950 given in the earlier paper, and are found to be consistent with Bradbury's hypothesis for the formation of the F_2 layer.

551.510.535 **874**

World-Wide Daily Variations in the Height of the Maximum Electron Density in the Ionospheric F_2 Layer.—J. W. Wright & R. E. McDuffie: T. Shimazaki. (*J. Radio Res. Labs, Japan*, July 1960, Vol. 7, No. 32, pp. 409–420.) The heights given by the method of Shimazaki (419 of 1956) which related $(M3000)F_2$ and the height of a parabolic F layer, have been compared with the more correct values derived from corresponding $N(h)$ profiles. The agreement between the two methods is quite good during the night in middle and low latitudes but during the day in these latitudes and for all hours at high latitudes Shimazaki's relation overestimates the height by about 20 km.

551.510.535 **875**

Investigation of the Formation of the Ionospheric F_2 Layer at Léopoldville-Binza.—P. Herrinck. (*Ann. Géophys.*, Jan.–March 1960, Vol. 16, No. 1, pp. 77–87.) Data for the period 1952–1958 are analysed. Photo-ionization and drift are insufficient to explain the variations of maximum electron density; additional ionization due to corpuscles accelerated in a region near the earth is suggested.

551.510.535 **876**

Bifurcation and other Irregularities of the Ionospheric F_2 Layer.—E. Woyk (Chvojková). (*Nature, Lond.*, 10th Dec. 1960, Vol. 188, No. 4754, pp. 906–907.) Splitting is considered to occur when the excess of energy of each ionizing photon over the ionizing potential is transformed into heat. On account of the quasi-neutrality, the rarefaction of the gas at the maximum of ionization can create a small secondary minimum of electron density which separates the F layer into F_1 and F_2. This secondary minimum of electron density appears just at the maximum of electron production.

551.510.535 **877**

Effects of Diffusion of Electrons near the Magnetic Equator.—V. C. A. Ferraro, J. E. C. Gliddon & P. C. Kendall. (*Nature, Lond.*, 17th Dec. 1960, Vol. 188, No. 4755, pp. 1017–1018.) If it is assumed that ionization in the F_2 layer is produced according to Chapman's law, then, as the magnetic equator is approached the rate of increase in ionization will exceed any decrease due to the effects of vertical diffusion described by Schmerling (4224 of 1960). The hypothesis of vertical diffusion does not therefore account for the 'geomagnetic anomaly'.

551.510.535 **878**

The Geomorphology of Spread-F.—D. G. Singleton. (*J. geophys. Res.*, Nov. 1960, Vol. 65, No. 11, pp. 3615–3624.) The occurrence of spread-F is roughly symmetrical about the geomagnetic equator, and is greatest in the equatorial and auroral regions. It occurs mainly during the night, and is greatest in winter in the auroral region, and at equinox in the equatorial region.

551.510.535 **879**

The Belt of Equatorial Spread-F.—A. J. Lyon, N. J. Skinner & R. W. H. Wright. (*J. atmos. terr. Phys.*, Dec. 1960, Vol. 19, Nos. 3/4, pp. 145–159.) I.G.Y. data are used to discuss the morphology of nocturnal spread-F incidence in the equatorial belt and this is compared with the morphology of the post-sunset increase of F-layer virtual height. Between magnetic latitudes $\pm 30°$, the incidence of spread-F is high, but decreases during periods of magnetic disturbance. Existing theories are inadequate to explain the observations.

551.510.535: 523.745 **880**

M.U.F. Factor and Solar Activity.—C. S. R. Rao & J. C. Bhargava. (*Indian J. Phys.*, Feb. 1960, Vol. 34, No. 2, pp. 85–91.) An analysis of ionospheric data for Delhi and Ahmedabad indicates that a linear relation exists between $(M3000)F_2$ and the sunspot number for both places.

551.510.535: 550.385.4 **881**

Hydromagnetic Waves in the Ionosphere.—W. E. Francis & R. Karplus. (*J. geophys. Res.*, Nov. 1960, Vol. 65, No. 11, pp. 3593–3600.) The results of numerical integration of the hydromagnetic wave equations in the ionosphere are presented. Earlier estimates of ionospheric heating by hydromagnetic waves are confirmed.

551.510.535: 550.507.362.1 **882**

Electron Densities in the F Region of the Ionosphere from Rocket Measure-

ments: Parts 1 & 2.—J. S. Nisbet & S. A. Bowhill. (*J. geophys. Res.*, Nov. 1960, Vol. 65, No. 11, pp. 3601–3614.) The recording and analysis of Faraday-rotation and range-error measurements on radio waves from long-range military and satellite-launching rockets are described. Corrections for horizontal gradients and refraction are included. The results from seven launchings show that the vertical electron-density gradient is greatest near sunrise and lowest after sunset, suggesting a time lag before diffusive equilibrium is reached.

551.510.535: 621.391.812.63 **883**

The D_1, D_2 Layers and the Absorption of Radio Waves.—G. C. Rumi. (*J. geophys. Res.*, Nov. 1960, Vol. 65, No. 11, pp. 3625–3630.) The possibility of separating absorption at different levels in the lower ionosphere is discussed theoretically with experimental examples.

551.510.535: 621.391.812.63.029.45 **884**

The Sunrise in the Ionosphere and its Repercussions on Long-Wave Propagation.—J. Ricker. (*Geofis. pura appl.*, May-Aug. 1960, Vol. 46, No. 2, pp. 241–328. In French.) The basic data are the records made at Zurich of the variations in number and direction of arrival of atmospherics at a frequency of 27 kc/s. The sudden fall in number of received atmospherics near dawn is attributed to the sunrise at a height of 75 km at a point on the wave trajectory. The height of the ozone layer is found to be 28 km. The transitory 'nose effect' in recordings of atmospherics is attributed to the transition from D-layer to E-layer propagation.

551.510.536 **885**

Physical Parameters of the Atmospheric Escape Layer.—J. J. Gilvarry. (*Nature, Lond.*, 3rd Dec. 1960, Vol. 188, No. 4753, pp. 804–805.) The height of the atmospheric escape layer is approximately 670 km in the daytime dropping to 480 km at night. The temperature of the layer is too low to cause the dissipation of helium-4 from the atmosphere and it is suggested that this process occurs during solar disturbances.

551.510.62: 551.508.8 **886**

Adaptation of the Radiosonde for Direct Measurement of Radio Refractive Index.—A. H. Clinger & A. W. Straiton. (*Bull. Amer. met. Soc.*, May 1960, Vol. 41, No. 5, pp. 250–252.) The system described is based on standard meteorological sensing devices and provides an accuracy sufficient for many radio-propagation applications.

551.594.5 **887**

On the Magnetic Time Dependence of the Auroral Zone Currents.—B. Hultqvist & G. Gustafson. (*J. atmos. terr. Phys.*, Dec. 1960, Vol. 19, Nos. 3/4, pp. 246–259.) The geomagnetic time for the evening passage of the geomagnetic component H through the zero-disturbance level was measured at Kiruna and College on 386 days. A time difference of 42 min was found, only part of which can be explained by means of higher spherical harmonic terms of the geomagnetic field.

551.594.5: 550.385.4 **888**

A Dynamo Theory of the Aurora and Magnetic Disturbance.—K. D. Cole. (*Aust. J. Phys.*, Sept. 1960, Vol. 13, No. 3, pp. 484–497.) A model of the aurora is examined in which a slab of ionized air exists parallel to the geomagnetic field. A wind of neutral molecules causes movement of the aurora and certain features of auroral and magnetic disturbances are explained.

551.594.6 **889**

Radiation from Protons of Auroral Energy in the Vicinity of the Earth.—W. B. Murcray & J. H. Pope. (*J. geophys. Res.*, Nov. 1960, Vol. 65, No. 11, pp. 3569–3574.) Cyclotron radiation of protons in the earth's magnetic field could be one source of dawn chorus.

551.594.6 **890**

Choice of a Parameter Characterizing Radio Whistlers.—Y. Corcuff. (*Ann. Géophys.*, Jan.–March 1960, Vol. 16, No. 1, pp. 128–139.) The dispersion D is proposed as a character-figure for whistlers. It is also proposed that as long whistlers have a dispersion which is dependent on frequency, the frequency should be stated; zero frequency is considered optimum for this purpose.

551.594.6 **891**

Travelling-Wave Amplification of Whistlers.—N. M. Brice. (*J. geophys. Res.*, Nov. 1960, Vol. 65, No. 11, pp. 3840–3842.) Theory of the travelling-wave tube is applied to a.f. waves in the ionosphere to explain the generation of whistlers.

551.594.6: 551.594.5 **892**

Auroral Noise at H.F.—R. D. Egan & A. M. Peterson. (*J. geophys. Res.*, Nov. 1960, Vol. 65, No. 11, pp. 3830–3832.) Observations made with fixed-frequency back-scatter equipment and riometers are discussed.

551.594.6: 621.391.821 **893**

On the Theory of Amplitude Distribution of Impulsive Random Noise and its Application to the Atmospheric Noise.—K. Furutsu & T. Ishida. (*J. Radio Res. Labs., Japan*, July 1960, Vol. 7, No. 32, pp. 279–307, charts.) Atmospheric noise is considered to be a superposition of sources of independent randomly occurring Poisson noise wave packets. Theoretical amplitude distributions from both discrete and continuous spatial distributions of sources are compared with actual noise measurements with considerable agreement.

551.510.535 **894**

Physics of the Upper Atmosphere. [Book Review].—J. A. Ratcliffe (Ed.). Publishers: Academic Press, New York, 1960, 586 pp., $14·50. (*J. atmos. terr. Phys.*, Dec. 1960, Vol. 19, Nos. 3/4, p. 295.)

LOCATION AND AIDS TO NAVIGATION

621.396.933 **895**

Doppler Navigation and Tracking.—B. R. Gardner. (*Proc. Inst. Radio Engrs*, Dec. 1960, Vol. 48, No. 12, pp. 2016–2017.) A airborne Doppler c.w. mapping system operating on 9·25 Gc/s is briefly described and some results are given.

621.396.96: 621.396.677.089.6 : 523.164.32 **896**

Aerial Calibration by Solar Noise using Polar Display.—Cufflin. (See 781.)

621.396.96.089.6: 523.164.32 **897**

Aerial Investigations using Natural Noise Sources.—E. Eastwood. (*Marconi Rev.*, 1st Quarter 1960, Vol. 23, No. 136, pp. 2–20.) Experiments are described using radiation from the quiet sun as a means of measuring the polar diagrams of 1·5-m-λ and microwave radar systems. A moon-reflected solar noise signal is also reported.

621.396.96.089.6: 523.164.32 **898**

Some Measurements on Radar Aerials, using Stellar Noise.—M. J. B. Scanlan. (*Marconi Rev.*, 1st Quarter 1960, Vol. 23, No. 136, pp. 21–32.) Some measurements of the vertical polar diagrams of radar aerials, using the sun as the source of radiation, are presented. Other celestial objects are considered as possible radiators for the calibration of aerials.

621.396.969.36 **899**

Far-Field Scattering from Bodies of Revolution.—K. M. Siegel. (*Appl. sci. Res.*, 1958, Vol. B7, No. 4, pp. 293–328.) By the use of approximations based on physical reasoning, radar cross-sections for bodies of revolution are determined. See also 4073 of 1959 (Brysk et al.) and *ibid.*, 1959, Vol. B8, No. 1, pp. 8–12 (Siegel et al.).

621.396.969.36 **900**

Effects of the Dielectric Coatings with Nonuniform Thickness on the Radar Cross-Section of the Perfectly Conducting Sphere.—A. Komata & Y. Mushiake. (*Sci. Rep. Res. Inst. Tohoku Univ., Ser. B*, 1960, Vol. 11, Nos. 3/4, pp. 191–201.)

MATERIALS AND SUBSIDIARY TECHNIQUES

535.215: 539.23 **901**

On High-Voltage Photoelectromotive Forces in Thin Semiconductor Layers.—V. M. Lyubin & G. A. Fedoreova. (*Dokl. Ak. Nauk S.S.S.R.*, 1st Dec. 1960, Vol. 135, No. 4, pp. 833–836.) Measurements have been made of the photo-e.m.f. in CdTe, Sb_2Se_3 and Sb_2S_3-BiS_3 films. Results are shown graphically. In some samples photovoltages of 150–180 V/cm were obtained at room temperature.

535.215: 546.47'221: 539.23 **902**

Hole Mobility and Crystal Size in Lead Sulphide Photoconductive Films.—H. E. Spencer & J. V. Morgan. (*J. appl. Phys.*, Nov. 1960, Vol. 31, No. 11, pp. 2024–2027.)

535.215 + 535.37]: 546.48'221 **903**

The Temperature Dependence of the Absorption Edge in CdS Crystals.—H.

Radelt. (*Z. Naturf.*, March 1960, Vol. 15a, No. 3, pp. 269–270.) Preliminary report on measurements of the spectral distribution of transmission in the range from 5 500 Å to the absorption edge at temperatures down to 21°K. This is an extension of earlier measurements and results agree with those of other authors [e.g. 1208 of 1959 (Dutton)].

535.215: 546.48'221 **904**

Further Experimental Evidence on Majority-Carrier Injection in CdS Single Crystals.—I. T. Steinberger. (*J. Phys. Chem. Solids*, Oct. 1960, Vol. 15, Nos. 3/4, pp. 354–355.) The work of Smith & Rose (2666 of 1955) and of Böer & Kümmel (2749 of 1958) is discussed; further experiments are described which show that the results of Smith & Rose can be explained only on the assumption of majority-carrier injection, and cannot be accounted for by bulk liberation of carriers.

535.215: 546.48'221 **905**

Direct Observation of Exciton Motion in CdS.—D. G. Thomas & J. J. Hopfield. (*Phys. Rev. Lett.*, 1st Dec. 1960, Vol. 5, No. 11, pp. 505–507.)

535.37 **906**

Excitation Spectra of Vanadium-Activated Zinc and Cadmium Sulphide and Selenide Phosphors.—G. Meijer & M. Avinor. (*Philips Res. Rep.*, June 1960, Vol. 15, No. 3, pp. 225–237.) The emission in the 2 μ fluorescence band is excited by absorption in two composite bands due to vanadium at 1·1 and 1·6 eV, by absorption in an auxiliary impurity centre, such as copper or silver, if present, and by fundamental excitation. See also 3121 of 1960 (Avinor & Meijer).

535.37: [546.47'221 + 546.48'221 **907**

Polarization of Fluorescence in CdS and ZnS Single Crystals.—J. L. Birman. (*J. electrochem. Soc.*, May 1960, Vol. 107, No. 5, pp. 409–417.) A number of models are proposed in which the energy-level structure of centres is consistent with observations of polarization. The Lambe-Klick model is preferred for its simplicity but conclusive data are at present lacking.

535.37: [546.47'221 + 546.48'221 **908**

Polarization of Luminescence in ZnS and CdS Single Crystals.—A. Lempicki. (*J. electrochem. Soc.*, May 1960, Vol. 107, No. 5, pp. 404–409.) The fluorescent emission from hexagonal ZnS and CdS single crystals is found to be polarized preferentially perpendicular to the c axis for both polarized and unpolarized excitation. Cubic ZnS crystals emit unpolarized radiation.

535.37: 546.47'221 **909**

Fluorescence of some Activated ZnS Phosphors.—W. van Gool, A. P. Cleiren & H. J. M. Heijligers. (*Philips Res. Rep.*, June 1960, Vol. 15, No. 3, pp. 254–274.) The effects of different activators (Ag, Cu, Au) and co-activators (Al, Sc, Ga, In) are studied, in all combinations and at room temperature and −196 °C.

535.37: 546.47'221 **910**

Self-Activated and Co-Activated Luminescence of ZnS.—W. van Gool & A. P. Cleiren. (*Philips Res. Rep.*, June 1960, Vol. 15, No. 3, pp. 238–253.) Kröger's theory of these emissions [see e.g. 2228 of 1950 (Kröger & Dikhoff)] is reviewed, and further experimental data are presented, especially regarding the temperature dependence of the fluorescence bands.

535.37: 546.47'48'221 **911**

Effect of CdS Addition in ZnS : Cu,In and ZnS : Ag,In Phosphors.—E. F. Apple. (*J. electrochem. Soc.*, May 1960, Vol. 107, No. 5, pp. 418–422.) "ZnS : Cu,In and ZnS : Ag,In phosphors each can show two emission bands under 3 650 Å excitation, namely, in the green (short) and orange (long) with Cu and in the blue and yellow with Ag activator. Addition of CdS causes the ratio of intensities of the short to long wavelength emission to increase. This observation is interpreted using the donor-acceptor associated pair model proposed recently for the long wavelength emission process [187 of 1960 (Apple & Williams)]."

535.376 **912**

A Note on Electroluminescence due to Carrier Accumulation.—H. K. Henisch & B. R. Marathe. (*Proc. phys. Soc.*, 1st Nov. 1960, Vol. 76, No. 491, pp. 782–783.) Some observations of electroluminescence, at present attributed to injection, could be due to recombination of accumulated carriers.

535.376 **913**

Apparatus for the Study of Luminescent Substances under the Action of Cathodic Bombardment.—F. Gans. (*C. R. Acad. Sci., Paris*, 7th March 1960, Vol. 250, No. 10, pp. 1821–1823.) In the apparatus described the screen is magnetically coupled to a motor rotating at a speed of 2 800 rev/min. Results obtained with screens of CdS are briefly reported.

535.376 **914**

The Light Waveforms Emitted from Electroluminescent Cells Energized by Square Waves and Pulses of Voltage.—G. R. Hoffman & D. H. Smith. (*J. Electronics Control*, Sept. 1960, Vol. 9, No. 3, pp. 161–216.) Light pulses which rise to a maximum in less than 0·2 μs can be obtained from electroluminescent cells under square-wave excitation. The pulses decay more slowly, taking from 2 to 3 μs to decay to one-third of their maximum amplitude at a repetition frequency of 50 kc/s, and about 100 μs at 200 c/s. A proposed model of a phosphor crystal is discussed and the predicted effects on the light waveforms of variation in frequency, pulse width and temperature are correlated with observations.

535.376: 546.47'221 **915**

CdS : Cu,Cl Electroluminescent Phosphors.—A. Wachtel. (*J. electrochem. Soc.*, March 1960, Vol. 107, No. 3, pp. 199–208.)

535.376 + 535.215]: 546.681'18 **916**

***P-N* Luminescence and Photovoltaic Effects in GaP.**—H. G. Grimmeiss & H. Koelmans. (*Philips Res. Rep.*, June 1960, Vol. 15, No. 3, pp. 289–301.) Depending on the method of preparation, GaP crystals show either p- or n-type conductivity. Non-doped crystals show electroluminescence, point-contact rectification and photovoltaic effects. A level scheme for GaP is proposed. The wavelength dependence of the photovoltage has been found, and an explanation in terms of optical and thermal effects is given.

537.227 **917**

Some Properties of Ferroelectrics at a Frequency of 3 000 Mc/s.—V. M. Petrov. (*Fiz. Tverdogo Tela*, May 1960, Vol. 2, No. 5, pp. 997–1001.) The small-signal u.h.f. permittivity ϵ and loss tangent $\tan\delta$ of single-crystal and ceramic $BaTiO_3$ and of VK1 materials have been measured as a function of an applied d.c. field in the range 0–22 kV/cm. Both ϵ and $\tan\delta$ decrease on application of the d.c. field. Hysteresis and aging effects are observed.

537.227 **918**

Ferroelectric Domain Delineation in Triglycine Sulphate and Domain Arrays Produced by Thermal Shocks.—A. G. Chynoweth & W. L. Feldmann. (*J. Phys. Chem. Solids*, Oct. 1960, Vol. 15, Nos. 3/4, pp. 225–233.)

537.227 **919**

Kinematic Theory of Ferroelectric Domain Growth.—T. Nakamura. (*J. phys. Soc. Japan*, Aug. 1960, Vol. 15, No. 8, pp. 1379–1386.)

537.227 **920**

Switching Properties of Tetramethylammonium-trichloromercurate.—E. Fatuzzo. (*Proc. phys. Soc.*, 1st Nov. 1960, Vol. 76, No. 491, pp. 797–799.)

537.227: 546.431'824'28-31 **921**

The Problem of Replacement of a Titanium Ion by a Silicon Ion in Polycrystalline Barium Titanate.—L. N. Kamysheva. (*Fiz. Tverdogo Tela*, May 1960, Vol. 2, No. 5, pp. 1002–1003.) A note of measurements on $Ba(Ti,Si)O_3$ samples in weak 1-kc/s fields, showing the variation of permittivity with temperature in the range 80–160 °C.

537.227: 546.431'824-31 **922**

An Investigation of the Cubic-Hexagonal Transition in Barium Titanate.—R. M. Glaister & H. F. Kay. (*Proc. phys. Soc.*, 1st Nov. 1960, Vol. 76, No. 491, pp. 763–771.)

537.311.33 **923**

Resonance Transfer of Ionization Energy in Semiconductors.—S. Kashino & T. Ando. (*J. phys. Soc. Japan*, Aug. 1960, Vol. 15, No. 8, p. 1538.) An interpretation of anomalous thermal conductivity is given which involves dependence on the impurity concentration.

537.311.33 **924**

Integral Equations for Determining the Stability in Semiconductors.—W. Franz. (*Z. Naturf.*, April 1960, Vol. 15a, No. 4, pp. 360–365.) Equations are given for use in the iteration method of calculating the stability zones for strong-field conditions.

537.311.33 **925**

Free-Carrier Absorption due to Polar Modes in the III-V Compound Semiconductors.—S. Visvanathan. (*Phys. Rev.*, 15th Oct. 1960, Vol. 120, No. 2, pp. 376–378.) A quantum-mechanical calculation gives an absorption varying as $\lambda^{3.5}$ and such behaviour is observed experimentally in InP and GaP. The calculated value of the absorption coefficient in InP agrees with experiment.

537.311.33 **926**

Free-Carrier Absorption arising from Impurities in Semiconductors.—S. Visvanathan. (*Phys. Rev.*, 15th Oct. 1960, Vol. 120, No. 2, pp. 379–380.) Available data for bremsstrahlung have been used to calculate the absorption coefficient. Results agree with calculations by other methods. The inadequacy of the Born approximation is brought out.

537.311.33 **927**

Phenomenology of Impurity Conduction in Semiconductors.—E. C. McIrvine. (*J. Phys. Chem. Solids*, Oct. 1960, Vol. 15, Nos. 3/4, pp. 356–358.) A simple empirical relation is deduced between the critical impurity concentration above which temperature-independent impurity conduction is observed, and the static dielectric constant, using data on Ge, Si, InSb, SiC, CdS and Mg_2Sn.

537.311.33 **928**

Measurement of Decay Times of Excess Carriers in Semiconductors, Excited by X-Ray Pulses.—J. A. W. van der Does de Bye. (*Philips Res. Rep.*, June 1960, Vol. 15, No. 3, pp. 275–289.) The experimental method is described. The decay times found are of the order of 3 μs, and are similar to those for excess carriers excited by pulses of light.

537.311.33: 535.215: 538.63 **929**

The Photomagnetic Effect in Isotropic Semiconductors and its Use in Measuring the Lifetime of Minority Current Carriers.—A. A. Grinberg. (*Fiz. Tverdogo Tela*, May 1960, Vol. 2, No. 5, pp. 836–847.) A convenient form of the kinetic equation is derived for current in the case of two types of carrier with the same sign. This is used to determine the photocurrent and photomagnetic e.m.f. in an arbitrary magnetic field. The photomagnetic method of measuring carrier lifetime is discussed and formulae are derived for determining the lifetime in strong fields.

537.311.33: 537.32 **930**

Thermal Conductivity of Semiconductor Solid Solutions.—A. V. Ioffe & A. F. Ioffe. (*Fiz. Tverdogo Tela*, May 1960, Vol. 2, No. 5, pp. 781–792.) The mechanism of thermal conduction is discussed with special reference to the scattering of phonons by impurities. Results of an experimental investigation of a wide range of semiconductors are tabulated and shown graphically.

537.311.33: 546.289.6 **931**

Magneto-plasma Resonance in Semiconductors.—S. Iida. (*J. phys. Soc. Japan*, Aug. 1960, Vol. 15, No. 8, pp. 1488–1492.) Theory developed for the general case where several kinds of free carriers are moving under a static magnetic field, shows that under certain conditions, the resultant plasma frequency can be determined as though there were only one kind of carrier with the reduced mass of all the carriers concerned.

537.311.33: 538.63 **932**

Theory of the Ettingshausen Effect in Semiconductors.—B. V. Paranjape & J. S. Levinger. (*Phys. Rev.*, 15th Oct. 1960, Vol. 120, No. 2, pp. 437–441.) The Ettingshausen coefficient P is calculated and discussed for intrinsic p-type and n-type semiconductors. Results agree reasonably well with experimental data for P as a function of temperature for different samples of Ge and Si.

537.311.33: 538.63 **933**

Theory of the Absorption Edge in Semiconductors in a High Magnetic Field.—R. J. Elliott & R. Loudon. (*J. Phys. Chem. Solids*, Oct. 1960, Vol. 15, Nos. 3/4, pp. 196–207.) An extension of previous theory [see e.g. 501 of 1959 (Elliott et al.)] to include the effect of the Coulomb interaction of the hole-electron pair.

537.311.33: 538.63 **934**

Magneto-electrical Field-Effect Measurements.—E. Aerts. (*J. Electronics Control*, Sept. 1960, Vol. 9, No. 3, pp. 217–228.) Further experimental results are given on the influence of combined orthogonal transverse electric and magnetic fields on the mobility of the carriers in the space charge layer at the surface of a semiconductor. In particular, it is shown that the Hall field could change the type of surface layer. See 3154 of 1960 (Aerts et al.).

537.311.33: 546.23: 537.226.2: 3 **935**

Dielectric Investigations on Polycrystalline Selenium.—W. Ludwig. (*Z. Naturf.*, March 1960, Vol. 15a, No. 3, pp. 205–206.) Report on measurements of the dispersion characteristics of dielectric constant and loss angle of high-purity Se in the frequency range 0·5–1 000 kc/s between + 80° and −160°C.

537.311.33: 546.28 **936**

Optical Constants of Silicon in the Region 1 to 10 eV.—H. R. Philipp & E. A. Taft. (*Phys. Rev.*, 1st Oct. 1960, Vol. 120, No. 1, pp. 37–38.)

537.311.33: 546.28 **937**

Scattering Anisotropies in n-Type Silicon.—D. Long & J. Myers. (*Phys. Rev.*, 1st Oct. 1960, Vol. 120, No. 1, pp. 39–44.) Magnetoresistance measurements show that the main features of the scattering anisotropies can be represented by the relaxation time ratio $\tau_t/\tau_l \approx 2{\cdot}0$ for acoustic lattice scattering, and $\tau_t/\tau_l > 1$ for ionized-impurity scattering, where τ_t and τ_l are the relaxation times parallel and perpendicular to the constant-energy-ellipsoid axis.

537.311.33: 546.28 **938**

A Note on the Method of Determining Ambipolar Coefficients for Electrons and Holes in Silicon.—R. J. Nicholas. (*J. Electronics Control*, Sept. 1960, Vol. 9, No. 3, pp. 229–231.) An analytical note showing that ionization coefficients need not be equal for symmetrical pairs to have equal breakdown voltages, contrary to the analysis of Shields (2652 of 1959).

537.311.33: 546.28 **939**

On the Determination of Diffusion Coefficient of Boron in Silicon.—J. Yamaguchi, S. Horiuchi, K. Matsumura & Y. Ogino. (*J. phys. Soc. Japan*, Aug. 1960, Vol. 15, No. 8, pp. 1541–1542.) A note of measurements made in terms of the conductivity of the diffused layer.

537.311.33: 546.28 **940**

Long-Term Variations of the Field Effect in Silicon.—V. G. Litovchenko & O. V. Snitko. (*Fiz. Tverdogo Tela*, May 1960, Vol. 2, No. 5, pp. 815–822.) The main cause of long-term variations is the presence of water vapour in the atmosphere. Measurements in air and in vacuum are reported and a critical field is defined, above which an additional surface conductivity is observed. This conductivity persists for long periods after the field is removed.

537.311.33: 546.289 **941**

Impurity Conductivity of Germanium at Low Temperature.—B. M. Vul, E. I. Zavaritskaya & L. V. Keldysh. (*Dokl. Ak. Nauk S.S.S.R.*, 21st Dec. 1960, Vol. 135, No. 6, pp. 1361–1363.) Graphs show the variation of the current density and the drift velocity of holes with field strength at temperatures of 4·2, 14 and 20·4 °K.

537.311.33: 546.289 **942**

Concerning the Properties of Germanium in a Strong Electric Field.—G. M. Avak'yants. (*Fiz. Tverdogo Tela*, May 1960, Vol. 2, No. 5, pp. 810–814.) Brief analysis showing that Paranjape's theory (3543 of 1957) does not explain the hole mobility in p-type Ge. An interpretation is suggested which is based on interaction of holes with acoustic- and optical-mode lattice vibrations.

537.311.33: 546.289 **943**

Scattering of Hot Carriers in Germanium.—E. M. Conwell & A. L. Brown. (*J. Phys. Chem. Solids*, Oct. 1960, Vol. 15, Nos. 3/4, pp. 208–217.) Theoretical study of the dependence of lattice mobility of hot carriers on their 'temperature', for lattice temperatures of 300, 78 and 20·4 °K. The effects of impurity scattering are briefly considered.

537.311.33: 546.289 **944**

Orientation Dependence Dissolution of Germanium.—F. C. Frank & M. B. Ives. (*J. appl. Phys.*, Nov. 1960, Vol. 31, No. 11, pp. 1996–1998.) The dissolution of single crystals of undoped Ge is shown to be almost completely dependent on orientation.

537.311.33: 546.289 **945**

Exciton and Magneto-optical Effects in Strained and Unstrained Germanium.—G. E. Stillman & V. J. Tekippe. (*Phys. Rev.*, 15th Oct. 1960, Vol. 120, No. 2, pp. 442–450.) Measurements indicate that the absorption peaks corresponding to transitions to certain [illegible] exciton [illegible]

Landau level in qualitative agreement with calculations of others. A definitive experiment is suggested to test this theory.

537.311.33: 546.289 **946**

Surface States on High-Purity Germanium.—K. Schnegraf & K. Seiler. (*Z. Naturf.*, April 1960, Vol. 15a, No. 4, pp. 368–369.) Results are discussed of measurements on Ge with impurity concentration $<10^{13}$/cm^3, and an interpretation is given of the surface states resulting from exposure to various gases.

537.311.33: 546.289 **947**

A Controlled Diffusion Process for Indium in *n*-Type Germanium.—F. Barson, M. J. Dyett, C. Karan & W. E. Mutter. (*J. electrochem. Soc.*, May 1960, Vol. 107, No. 5, pp. 459–461.) Experimental results are given to show that molten In in contact with Ge can be used both as a getter to prevent thermal conversion and simultaneously as a source of In vapour for diffusion into Ge. The surface concentration of In can be reduced by dilution with Sn.

537.311.33: 546.289: 538.24 **948**

Magnetic Susceptibility of *p*-Type Ge.—R. Bowers & Y. Yafet. (*Phys. Rev.*, 1st Oct. 1960, Vol. 120, No. 1, pp. 62–66.) Measured carrier susceptibility is compared with theoretical expectations to obtain information concerning the band structure.

537.311.33: 546.289: 538.569.4 **949**

Additional Spin Resonance Spectrum in Antimony-Doped Germanium.—R.W. Keyes & P. J. Price. (*Phys. Rev. Lett.*, 15th Nov. 1960, Vol. 5, No. 10, pp. 473–474.)

537.311.33: 546.289: 538.639 **950**

The Phonon Component of the Transverse Thermomagnetic Nernst Effect in *p*-Type Germanium.—Yu. N. Obraztsov, I. V. Mocham & T. V. Smirnova. (*Fiz. Tverdogo Tela*, May 1960, Vol. 2, No. 5, pp. 830–835.) Results of calculations are compared with experimental data for the temperature range 96–143 °K and magnetic fields up to 5 500 G.

537.311.33: 546.289: 621.382.23 **951**

Solvent Evaporation Technique for the Growth of Arsenic-Doped Germanium Single Crystals for Esaki Diodes.—F. A. Trumbore & E. M. Porbansky. (*J. appl. Phys.*, Nov. 1960, Vol. 31, No. 11, p. 2068.)

537.311.33: 546.47-31 **952**

Reactions of Lithium as a Donor and an Acceptor in ZnO.—J. J. Lander. (*J. Phys. Chem. Solids*, Oct. 1960, Vol. 15, Nos. 3/4, pp. 324–334.) The conditions for production of donors and acceptors by Li in ZnO are described. Solubilities and diffusion coefficients are given and also some results for the kinetics and equilibria of the displacement reaction.

537.311.33: 546.47'221: 537.32 **953**

Thermoelectricity and Thermal Conductivity in the Lead Sulphide Group of Semiconductors.—D. Greig. (*Phys. Rev.*, 15th Oct. 1960, Vol. 120, No. 2, pp. 358–365.) Results of measurements from 4 to 100 °K are given and discussed.

537.311.33: [546.47'231 + 546.47'241 **954**

Band Structure and Scattering Mechanisms in Single-Crystal Mercury Telluride and Selenide.—M. Rodot & H. Rodot. (*C. R. Acad. Sci., Paris*, 22nd Feb. 1960, Vol. 250, No. 8, pp. 1447–1449.) Measurements show that the conduction band is probably isotropic in HgTe and formed of ellipsoids in HgSe. In both materials scattering by acoustic phonons is predominant. For thermomagnetic properties of HgTe see 3779 of 1959 (Fumeron-Rodot & Rodot).

537.311.33: 546.57'86'241 **955**

A Structural Study of the Compound $AgSbTe_2$.—R. W. Armstrong, J. W. Faust, Jr, & W. A. Tiller. (*J. appl. Phys.*, Nov. 1960, Vol. 31, No. 11, pp. 1954–1959.)

537.311.33: 546.57'86'241 **956**

Anomalous Hall Effect in $AgSbTe_2$.—R. Wolfe, J. H. Wernick & S. E. Haszko. (*J. appl. Phys.*, Nov. 1960, Vol. 31, No. 11, pp. 1959–1964.) The measurement of both positive and negative Hall coefficients in different samples is attributed to the presence of a second phase of Ag_2Te. See also 3146 of 1960 (Rodot).

537.311.33: 546.623'682'86 **957**

Some Electrical Properties of the AlSb-InSb System.—Ya. Agaev & D. N. Nasledov. (*Fiz. Tverdogo Tela*, May 1960, Vol. 2, No. 5, pp. 826–829.) Investigation of the Hall effect and conductivity over a wide range of temperatures.

537.311.33: 546.681'18 **958**

Carrier Concentration and Hole Mobility in *p*-Type Gallium Phosphide.—G. F. Alfrey & C. S. Wiggins. (*Z. Naturf.*, March 1960, Vol. 15a, No. 3, pp. 267–268. In English.) Results of measurements on polycrystalline material in the temperature range 100–500 °K are given and compared with values predicted by other authors.

537.311.33: 546.681'19 **959**

Influence of Arsenic Pressure on the Doping of Gallium Arsenide with Germanium.—J. O. McCaldin & R. Harada. (*J. appl. Phys.*, Nov. 1960, Vol. 31, No. 11, pp. 2065–2066.)

537.311.33: 546.681'19 **960**

Diffusion of Cadmium into Gallium Arsenide.—F. A. Cunnell & C. H. Gooch. (*Nature, Lond.*, 24th Dec. 1960, Vol. 188, No. 4756, p. 1096.) See also 3945 of 1960 (Goldstein).

537.311.33: 546.682'86 **961**

Influence of the Electric Field on the Electrical Conductivity, Hall Coefficient, and Magnetoresistance of *n*-Type InSb at Low Temperature.—Lyan Chzichao & D. N. Nasledov. (*Fiz. Tverdogo Tela*, May 1960, Vol. 2, No. 5, pp. 793–798.) Observed deviations from Ohm's law may be explained by assuming that electrons in the impurity band are excited into the conduction band under the influence of the applied electric field.

537.311.33: 546.682'86 **962**

Calculation of Transport Effects for a Relaxation Time almost Independent of the Energy. Case of Indium Antimonide.—M. Rodot. (*C. R. Acad. Sci., Paris*, 29th Feb. 1960, Vol. 250, No. 9, pp. 1625–1627.)

537.311.33: 546.682'86: 535.215 **963**

Impurity Photoconductivity in *n*-Type InSb.—E. H. Putley. (*Proc. Phys. Soc.*, 1st Nov. 1960, Vol. 76, No. 491, pp. 802–805.) Photoconductivity is reported in InSb containing about 10^{14} impurities/cm^3 when irradiated at mm λ in magnetic fields of 6–9 kG, at temperatures of the order of 1–5°K.

537.311.33: 546.812'221 **964**

The Preparation and the Electrical and Optical Properties of SnS Crystals.—W. Albers, C. Haas & F. van der Maesen. (*J. Phys. Chem. Solids*, Oct. 1960, Vol. 15, Nos. 3/4, pp. 306–310.) Single crystals were prepared by heating the components to 900 °C, and zone refining. The crystals were of *p* type with a hole density of 10^{17}–10^{18} cm^{-3} and mobility 65 cm^2/V.sec at room temperature.

537.311.33: 546.817'231 **965**

Hall Coefficient and Electrical Conductivity Measurements on Lead Selenide Single Crystals Grown from the Vapour.—R. H. Jones. (*Proc. phys. Soc.*, 1st Nov. 1960, Vol. 76, No. 491, pp. 783–787.)

537.311.33: 547.491 **966**

Electronic Conduction and Exchange Interaction in a New Class of Conductive Organic Solids.—R. G. Kepler, P. E. Bierstedt & R. E. Merrifield. (*Phys. Rev. Lett.*, 1st Dec. 1960, Vol. 5, No. 11, pp. 503–504.) The salts of a radical-anion formed by the addition of an electron to tetracyanoquinodimethane show a high electrical conductivity. The electric and magnetic properties of two such salts are described briefly.

537.312.62 **967**

Direct Measurement of the Superconducting Energy Gap.—J. Nicol, S. Shapiro & P. H. Smith. (*Phys. Rev. Lett.*, 15th Nov. 1960, Vol. 5, No. 10, pp. 461–464.) The tunnelling I/V characteristic of an Al-Al_2O_3-Pb sandwich shows a negative-resistance region when both metals are superconducting. From this characteristic the energy gap for each metal is derived.

537.312.62 **968**

Electron Tunnelling between Two Superconductors.—I. Giaever. (*Phys. Rev. Lett.*, 15th Nov. 1960, Vol. 5, No. 10, pp. 464–466.) The energy gaps of Pb, In and Al are found from the tunnelling I/V characteristics of sandwiches of these metals with Al and Al_2O_3.

537.312.62: 538.63 **969**

Critical Fields of Superconducting Tin, Indium and Tantalum.—R. W. Shaw, D. E. Mapother & D. C. Hopkins. (*Phys. Rev.*, 1st Oct. 1960, Vol. 120, No. 1, pp. 88–91.)

538.22 **970**

Model of Exchange-Inversion Magnetization.—C. Kittel. (*Phys. Rev.*, 15th Oct. 1960, Vol. 120, No. 2, pp. 335–342.) A

thermodynamic theory is given of a class of magnetic crystals which transform from ferromagnetic to antiferromagnetic states as the temperature is varied. Applications are suggested.

538.221 971

Thermally Activated Ferromagnetic Domain Wall Motion.—F. D. Stacey. (*Aust. J. Phys.*, Sept. 1960, Vol. 13, No. 3, pp. 399–404.) An elementary theory is presented which is in close agreement with the results of Olsen & Mitchell (*J. appl. Phys.*, April 1959, Vol. 30, No. 4, Supplement, pp. 250S–259S).

538.221 972

Theory of Stability of the Magnetic States of Ferromagnetic Substances during Magnetization.—E. I. Kondorskiĭ. (*Zh. eksp. teor. Fiz.*, Oct. 1959, Vol. 37, No. 4(10), pp. 1110–1115.) Examination of the factors affecting stability of the magnetic states of a ferromagnetic single crystal with respect to external magnetic fields and elastic strains. An expression is derived giving the minimum value of the magnetic field and stress for which irreversible changes of the magnetization are observed.

538.221 973

Contribution of the Fermi Contact Term to the Magnetic Field at the Nucleus in Ferromagnets.—A. J. Freeman & R. E. Watson. (*Phys. Rev. Lett.*, 1st Dec. 1960, Vol. 5, No. 11, pp. 498–500.)

538.221 974

Contribution to the Theory of the Temperature Dependence of Ferromagnetic Anisotropy.—E. A. Turov & A. I. Mitsek. (*Zh. eksp. teor. Fiz.*, Oct. 1959, Vol. 37, No. 4(10), pp. 1127–1132.) Mathematical analysis based on the phenomenological theory of spin waves.

538.221 975

Domain Patterns on 'Cube-Textured' Silicon-Iron Sheet.—L. F. Bates & R. Carey. (*Proc. phys. Soc.*, 1st Nov. 1960, Vol. 76, No. 491, pp. 754–758.)

538.221 976

On the Effect of Heat Treatment in a Magnetic Field on Magnetic Properties of Iron-Aluminium Alloys.—M. Sugihara. (*J. phys. Soc. Japan*, Aug. 1960, Vol. 15, No. 8, pp. 1456–1460.)

538.221 : 537.312.62 977

On the Intermediate State in Ferromagnetic Superconductors.—G. F. Zharkov. (*Zh. eksp. teor. Fiz.*, Dec. 1959, Vol. 37, No. 6 (12), pp. 1784–1788.) Calculation of the range of external magnetic field values for which a single-domain ferromagnetic ellipsoid can exist in the intermediate state. See 1556 of 1960 (Matthias & Suhl).

538.221 : 538.569.4 978

Ferromagnetic Resonance and the Theory of Phases.—A. Coumes. (*C. R. Acad. Sci., Paris*, 1st Feb. 1960, Vol. 250, No. 5, pp. 819–821.) The two maxima in the absorption curve for a single-crystal disk of Fe-Si measured at a frequency of 9 375 Mc/s are explained in terms of the 'theory of phases' of Néel (*J. Phys. Radium*, Nov. & Dec. 1948, Vol. 9, Nos. 11 & 12, pp. 193–213 & 265–276).

538.221 : 538.63 979

Anomalies in Internal Friction and the Elasticity Modulus in Ferromagnetic Substances near the Curie Point.—K. P. Belov, G. I. Kataev & R. Z. Levitin. (*Zh. eksp. teor. Fiz.*, Oct. 1959, Vol. 37, No. 4 (10), pp. 938–943.)

538.221 : 539.12.04 980

Effect of Neutron Bombardment on the Magnetic Properties of Very-High-Permeability Iron.—G. Bozzi, A. Ferro & G. Montalenti. (*J. appl. Phys.*, Nov. 1960, Vol. 31, No. 11, pp. 2046–2047.) Samples show lower permeability and higher coercive force.

538.221 : 539.23 981

Magnetic Properties of Epitaxially Grown Films.—O. S. Heavens. (*Research, Lond.*, Oct. 1960, Vol. 13, No. 10, pp. 404–410.) Review of methods used and results achieved in the measurement of magnetic properties of epitaxially grown ferromagnetic films.

538.221 : 621.318.124 982

Origin of the Magnetic Anisotropy Energy of Cobalt Ferrite.—M. Tachiki. (*Progr. theor. Phys.*, June 1960, Vol. 23, No. 6, pp. 1055–1072.) The magnetic anisotropy of Co ferrite is considered to arise from the Co^{2+} ions in the crystalline field of low symmetry.

538.221 : 621.318.124 983

Magnetic Anisotropy of Iron-Cobalt Ferrite Measured by Ferromagnetic Resonance.—Y. Sugiura. (*J. phys. Soc. Japan*, Aug. 1960, Vol. 15, No. 8, pp. 1461–1468.) The cubic magnetic anisotropy and the uniaxial magnetic anisotropy induced by heat treatment in a magnetic field are measured in the temperature range 70–250°C.

538.221 : 621.318.124 : 538.65 984

Origin of Magnetoelastic Effects in Cobalt-Iron Ferrite.—J. C. Slonczewski. (*J. Phys. Chem. Solids*, Oct. 1960, Vol. 15, Nos. 3/4, pp. 335–353.) The influence of orbitally degenerate ions on the magnetostrictive strain and elastic energy of a ferrimagnetic crystal are calculated for a trigonal crystal field and cubic structure. Some comparisons are made with experimental data for Co-Fe ferrite.

538.221 : 621.318.134 985

Kinetics of Magnetic Annealing in Cobalt-Substituted Magnetite.—W. Palmer. (*Phys. Rev.*, 15th Oct. 1960, Vol. 120, No. 2, pp. 342–352.)

538.221 : 621.318.134 986

Ferrite Materials with Very Low Temperature Coefficient for High Frequencies.—R. Sibille. (*Onde élect.*, Sept. 1960, Vol. 40, No. 402, pp. 586–589.) Characteristic curves are given for a range of Ni-Zn ferrites with variations of permeability $\geq 0{\cdot}02\%$ per °C over the range −60° C to +250° C.

538.221 : 621.318.134 987

On the Magnetic Properties of Lanthanum Gallium Garnet.—K. P. Belov, M. A. Zaĭtseva & A. V. Ped'ko. (*Zh. eksp. teor. Fiz.*, June 1960, Vol. 38, No. 6, pp. 1972–1978.) Report and discussion of measurements of the variation of magnetization, coercive force and magnetostriction with temperature in Gd oxides of garnet and perovskite structure.

538.221 : 621.318.134 : 538.569.4 988

Influence of the Porosity on the Width of the Absorption Curve of Pure and Cr- and Al-Substituted Yttrium Garnet.—R. Vautier & A. J. Berteaud. (*C. R. Acad. Sci., Paris*, 7th March 1960, Vol. 250, No. 10, pp. 1812–1814.)

538.221 : 621.318.134 : 538.569.4 989

Ferrimagnetic Resonance in Rare-Earth-Doped Yttrium Iron Garnet: Part I—Field for Resonance.—J. F. Dillon, Jr. & J. W. Nielsen. (*Phys. Rev.*, 1st Oct. 1960, Vol. 120, No. 1, pp. 105–113.) A description of experiments on single-crystal spheres of doped Y-Fe garnet in the temperature range 1·5–25°K to determine the field required for ferrimagnetic resonance as a function of crystal direction.

538.221 : 621.318.134 : 548.0 990

Dislocations, Stacking Faults and Twins in the Spinel Structure.—J. Hornstra. (*J. Phys. Chem. Solids*, Oct. 1960, Vol. 15, Nos. 3/4, pp. 311–323.)

538.222 991

Etching Patterns on (100) Planes of the Single Crystal $K_3Co(CN)_6$.—H. Iwasaki. (*J. Radio Res. Labs, Japan*, July 1960, Vol. 7, No. 32, pp. 389–403.) Two types of pattern are observed: (*a*) a 'pyramidal' form predominating on the $(100)^+$ plane and attributed to dislocation lines, (*b*) a 'hill-like' form predominating on the $(100)^-$ plane and attributed to point defects.

538.222 : 538.569.4 992

Spin-Lattice Relaxation Times in Ruby at 34·6 Gc/s.—J. H. Pace, D. F. Sampson & J. S. Thorp. (*Proc. phys. Soc.*, 1st Nov. 1960, Vol. 76, No. 491, pp. 697–704.) The measured relaxation times show dependence on temperature, transition order, and Cr concentration. Maser action should be possible at relatively high temperatures. Preliminary results were noted earlier (2107 of 1960).

538.222 : 538.569.4 993

Rotational Properties of Paramagnetic Resonance Spectra of Noncubic Crystals.—M. Sachs. (*J. Phys. Chem. Solids*, Oct. 1960, Vol. 15, Nos. 3/4, pp. 291–305.)

MATHEMATICS

517.918 994

Laurent-Cauchy Transforms for Analysis of Linear Systems Described

by Differential-Difference and Sum Equations.—E. I. Jury: Y. H. Ku & A. A. Wolf. (*Proc. Inst. Radio Engrs*, Dec. 1960, Vol. 48, No. 12, pp. 2026–2027.) Comment on 2854 of 1960 and authors' reply.

519.271 **995**

Generalized Padé Approximation.—J. L. Stewart. (*Proc. Inst. Radio Engrs*, Dec. 1960, Vol. 48, No. 12, pp. 2003–2008.) Approximation by minimizing the magnitude of the complex error vector in the steady state is considered and its relation to conventional approximations for magnitude alone and phase alone is discussed.

MEASUREMENTS AND TEST GEAR

621.918.41 (083.74): 621.373.421.13 **996**

Atomic-Clock Accuracy for Crystal Oscillators.—K. Nygaard. (*Electronics*, 11th Nov. 1960, Vol. 33, No. 46, pp. 82–83.) A servo-system for locking crystal oscillators to a standard-frequency signal such as WWV is described.

621.317.3: 537.311.33 **997**

An Analysis of the Circuit of Dauphinee and Mooser for Measuring Resistivity and Hall Constant.—L. J. v.d. Pauw. (*Rev. sci. Instrum.*, Nov. 1960, Vol. 31, No. 11, pp. 1189–1192.) Switch capacitance is shown to introduce systematic errors whose magnitude is estimated; they can be eliminated by suitably placed trimming capacitors and a definite switching sequence. See 201 of 1956 (Dauphinee & Mooser).

621.317.35.029.4 **998**

Using Digital Techniques in L.F. Spectrum Analysis.—B. Grand, L. Packer & J. L. West. (*Electronics*, 11th Nov. 1960, Vol. 33, No. 46, pp. 78–81.) Spectrum analysis over the range 0·0·025 c/s–1 kc/s is made using a change-of-time-scale principle. Components of transient as well as harmonic content are measured.

621.317.412: 537.311.33 **999**

A Sensitive Magnetic Balance for Determining Small Differences in Susceptibility.—D. Geist. (*Z. Phys.*, 14th March 1960, Vol. 158, No. 3, pp. 359–366.) A torsion pendulum is described for measuring the susceptibility difference between semiconductor specimens with differing doping. For measurements carried out with this balance see 618 of February and back references.

621.317.444: 550.380.8 **1000**

Terrestrial-Field Magnetometer using Nuclear Paramagnetic Resonance with Dynamic Polarization of the Nuclei.—(*Onde élect.*, Sept. 1960, Vol. 40, No. 402, pp. 590–601.)

Part 1—Theoretical Considerations.—J. Freyssinon & I. Solomon (pp. 590–595).

Part 2—Design and Construction.—J. Freyssinon (pp. 596–601).

621.317.444: 621.385.832.032.26 **1001**

Investigation of Focusing Magnets.—M. Arnaud & O. Cahen. (*Rev. tech. Comp. franç. Thomson-Houston*, Feb. 1960, No. 32, pp. 41–58.) Description of a turbine magnetometer for recording fields of 1–10^4 oersteds. The measuring probes have a diameter of 6 or 9 mm and consist of a compressed-air-driven copper vane in which a current is induced under the influence of the magnetic field and which in turn induces current in a fixed coil connected to the recording amplifier. The magnetometer is used in conjunction with an electrolyte tank to design focusing systems for O-type tubes.

621.317.7: 621.373.42.029.5
: 621.396.67.08 **1002**

A Portable H.F. Spectrum Generator for Antenna Calibration.—N. Burtnyk. (*Electronic Engng*, Dec. 1960, Vol. 32, No. 394, pp. 767–769.) Description of a pulsed harmonic generator providing signals at 200-kc/s intervals from 200 kc/s to 30 Mc/s with a high order of stability, which is attained by use of a crystal.

621.317.725 **1003**

An Electronic Digital Voltmeter.—J. L. J. van Vroonhoven & A. M. Muhlbaum. (*Instrum. Practice*, Dec. 1960, Vol. 14, No. 12, pp. 1317–1319.) The experimental voltmeter is described with a range of 0–1 V and operating at a rate of 100 measurements/sec; it incorporates secondary-emission distributor tubes as stepping switches [see *ibid.*, pp. 1313–1316 (van Vroonhoven)].

621.317.733 **1004**

A Method of Controlling the Effect of Resistance in the Link Circuit of the Thomson or Kelvin Double Bridge.—D. Ramaley. (*J. Res. nat. Bur. Stand.*, Oct.–Dec. 1960, Vol. 64C, No. 4, pp. 267–270.) Simple modifications to minimize the potential difference in the link circuit include a supplementary power source and an auxiliary galvanometer. A step-by-step procedure is outlined for making measurements with bridges incorporating these modifications.

621.317.737.029.65 **1005**

High-*Q* Wavemeter Design.—E. F. Goodenough. (*Marconi Rev.*, 2nd Quarter 1960, Vol. 23, No. 137, pp. 85–98.) The principles and comprehensive design details are given for a cavity-resonator type of wavemeter. For a particular wavemeter covering the frequency range 33–36 Gc/s a *Q* of over 70 000 is claimed.

621.317.77.088: 621.372.852.2 **1006**

Error Analysis of a Standard Microwave Phase Shifter.—Schafer & Beatty. (See 777.)

OTHER APPLICATIONS OF RADIO AND ELECTRONICS

531.7: 538.632 **1007**

Mechanical Measurement.—M. Nalęcz. (*Electronic Technol.*, Jan. 1961, Vol. 38, No. 1, pp. 15–17.) A method of measuring small displacements utilizing the Hall effect in semiconductors is described.

531.719.33: 621.3.087.4 **1008**

Water-Level Surge Recorder.—E. G. Sandels. (*Electronic Technol.*, Jan. 1961, Vol. 38, No. 1, pp. 2–10.) The circuits, including a two-stage active *RC*-network low-pass filter with a cut-off frequency of 0·07 c/s, are fully described.

621.362: 621.387 **1009**

Effect of Magnetic Fields on Thermionic Power Generators.—A. Schock. (*J. appl. Phys.*, Nov. 1960, Vol. 31, No. 11, pp. 1978–1987.) The high currents present in large thermionic power generators produce magnetic fields which reduce efficiency. An applied magnetic field parallel to the current flow will correct this. The possibility of generating alternating current by using a modulated field-coil current is noted. See also 4353 of 1960 (Garvin et al.).

621.362: 621.387 **1010**

Effect of Interelectrode Spacing on Cesium Thermionic Converter Performance.—R. L. Hirsch. (*J. appl. Phys.*, Nov. 1960, Vol. 31, No. 11, pp. 2064–2065.) The graphs presented show that efficiency is very dependent upon electrode spacing for medium-temperature devices, where Cs is used to modify emitter work function and space charge.

621.383: 535.24 **1011**

Double-Modulation Photometer.—H. P. Kalmus. (*Rev. sci. Instrum.*, Aug. 1960, Vol. 31, No. 8, pp. 828–832.) Details are given of a bridge instrument in which the photocurrent is modulated by an r.f. signal of 1 Mc/s chopped at 75 c/s. A signal/noise ratio of 100 may be obtained at a bandwidth of 1 c/s; the maximum sensitivity is 4×10^{-9} lu.

621.383.681.6 **1012**

Nonscanning Character Reader uses Coded Wafer.—L. R. Brown. (*Electronics*, 25th Nov. 1960, Vol. 33, No. 48, pp. 115–117.) Description of a lenticular-array/photocell system for recognizing characters or patterns.

621.385.833 **1013**

Fifth-Order Spherical Aberration of Magnetic Lenses.—G. D. Archard. (*Brit. J. appl. Phys.*, Nov. 1960, Vol. 11, No. 11, pp. 521–522.) For moderate-strength lenses of the bell-shaped-field type, third- and fifth-order coefficients are numerically very similar.

621.387.464 **1014**

Performance of Large-Area Scintillation Counters.—C. F. Barnaby & J. C. Barton. (*Proc. phys. Soc.*, 1st Nov. 1960, Vol. 76, No. 491, pp. 745–753.) The light collection efficiency is shown to be greater if the photomultiplier is in optical contact with the phosphor. Counters with and without this advantage are compared with an experimental design described.

621.398: 621.387.4 **1015**

Telemetering Radiation Data by Frequency Variation.—H. K. Richards.

(*Electronics*, 11th Nov. 1960, Vol. 33, No. 46, pp. 84–87.) The relative advantages of three types of radiation monitor are discussed.

PROPAGATION OF WAVES

621.391.812.5: 523.5 **1016**

Volume Density of Radio Echoes from Meteor Trails.—N. Carrara, P. F. Checcacci & L. Ronchi. (*Proc. Inst. Radio Engrs*, Dec. 1960, Vol. 48, No. 12, pp. 2031–2032.) A method is described for determining the number of echoes received per unit time as a function of the region of the sky where the receiver beam crosses the transmitter beam.

621.391.812.5: 523.5 **1017**

The Fading of Radio Waves Reflected Obliquely from Meteor Trails.—G. S. Kent. (*J. atmos. terr. Phys.*, Dec. 1960, Vol. 19, Nos. 3/4, pp. 272–283.) Bursts of signal received over a distance of 500 km on a frequency of 53 Mc/s in England have been studied. Spaced aerials allowed the structure of the diffraction pattern to be estimated. The reasons for the observed fading of the signals have been deduced.

621.391.812.62 **1018**

Some Thoughts on the Propagation of Radio Waves Through the Troposphere.—J. A. Saxton. (*Onde élect.*, July/Aug. 1960, Vol. 40, Nos. 400/401, pp. 505–514.) A survey of developments in the field of tropospheric propagation and a review of current theories advanced to explain propagation beyond the horizon; the most satisfactory model is considered to be one based on a layered troposphere. 58 references.

621.391.812.62 **1019**

Radio Wave Propagation and Attenuation in the Troposphere.—E. M. Hickin. (*Research, Lond.*, Dec. 1960, Vol. 13, No. 12, pp. 503–506.) The attenuation of microwaves due to meteorological phenomena is discussed. Contours are given of constant path length for equal "out-of-service" time for 11-Gc/s radio links in Europe; these contours are based on published rainfall data.

621.391.812.621 **1020**

The Equivalent Gradient: Direct Measurement and Theoretical Calculation.—P. Misme. (*Ann. Télécommun.*, March/April 1960, Vol. 15, Nos. 3/4, pp. 92–99.) If variations in the gradient of the refractive index as a function of height are ignored, the path between transmitter and receiver may be drawn as an arc of a circle defined by the positions of both ends of the link and the transmission angle. This corresponds to a constant refractive-index gradient called the 'equivalent gradient'. Experimental values of this gradient have been obtained from radar measurements between Corsica and Southern France and theoretical values are calculated for Niamey in West Africa. See also *Trans. Inst. Radio Engrs*, July 1958, Vol. AP-6, No. 3, pp. 289–292.

621.391.812.63 **1021**

Scattering of Electromagnetic Waves from a Nondegenerate Ionized Gas.—J. Renau. (*J. geophys. Res.*, Nov. 1960, Vol. 65, No. 11, pp. 3631–3640.) The scattering cross-section for an ionized gas in thermal equilibrium is derived and compared with ionospheric experimental observations. The cross-section of turbulent irregularities is also discussed, and the relative importance of the two kinds of scattering at different wavelengths is considered.

621.391.812.63 **1022**

Flutter Fading of Short-Wave Radio Signals in Equatorial Regions and its Connection with Spread Echoes, Magnetic Storms and the Radiation Belt.—C. Lal. (*J. Instn Telecommun. Engrs, India*, Aug. 1960, Vol. 6, No. 5, pp. 223–230.) The effect of flutter fading on the broadcasting services of All India Radio is summarized. The cause is assumed to be the turbulence created by interaction between high-energy particles of the inner Van Allen belt and the upper edge of the F region when it rises soon after local sunset.

621.391.812.63: 551.510.535 **1023**

The D_1, D_2 Layers and the Absorption of Radio Waves.—Rumi. (See 883.)

RECEPTION

621.391.822: 551.578.1 **1024**

The Effect of Rain on the Noise Level of a Microwave Receiving System.—D. C. Hogg & R. A. Semplak. (*Proc. Inst. Radio Engrs*, Dec. 1960, Vol. 48, No. 12, pp. 2024–2025.) A note on the noise levels observed using a low-noise receiving system [1379 of 1960 (DeGrasse et al.)], which are much higher when rain occurs or is imminent at the receiver location.

621.396.62.001.4 **1025**

The Monitoring of Receiver Performance under Operational Conditions.—O. E. Keall. (*Marconi Rev.*, 2nd Quarter 1960, Vol. 23, No. 137, pp. 53–58.) Techniques for checking receiver performance using a gas-discharge noise source to provide a constant signal are discussed. Block schematic diagrams are given for suggested daily and semi-automatic checks and for continuous monitoring.

STATIONS AND COMMUNICATION SYSTEMS

621.396.215 **1026**

A Comparison between Alternative H.F. Telegraph Systems.—J. V. Beard & A. J. Wheeldon. (*Point to Point Telecommun.*, June 1960, Vol. 4, No. 3, pp. 20–48.) The comparison is in terms of an ideal detector. In h.f. propagation a two-tone system gives substantially the best performance for multichannel telegraphy, and is slightly superior to F.S.K. for simple-channel telegraphy.

621.396.215 **1027**

An Improved Decision Technique for Frequency-Shift Communications Systems.—E. Thomas. (*Proc. Inst. Radio Engrs*, Dec. 1960, Vol. 48, No. 12, pp. 1998–2003.) Description of a variable-decision-threshold device which enables a frequency-shift signalling system to use information in mark and space channels independently, resulting in an improvement in circuit quality where fading exists between mark and space frequencies. Results of tests over several ionospheric scatter circuits show improvements in signal detectability of 10–16 dB.

621.396.4 **1028**

Interstitial Channels for Doubling TD-2 Radio System Capacity.—H. E. Curtis, T. R. D. Collins & B. C. Jamison. (*Bell Syst. tech. J.*, Nov. 1960, Vol. 39, No. 6, pp. 1505–1527.) Laboratory and field measurements show that by using cross-polarization aerial systems and i.f. filters the interstitial channels can be operated without detriment to the existing channels.

621.396.43: 551.507.362.2 **1029**

A Possible Long-Range Communications Link between Ground and Low-Orbiting Satellites.—M. S. Macrakis. (*J. atmos. terr. Phys.*, Dec. 1960, Vol. 19, Nos. 3/4, pp. 260–271.) Under certain restrictive conditions a ray properly injected into the ionosphere can travel long distances without entering the upper atmosphere. A possible method of injection is discussed.

621.396.97: 534.76 **1030**

Engineering Performance of Six Proposed Stereo Systems.—A. P. Walker. (*Electronics*, 18th Nov. 1960, Vol. 33, No. 47, pp. 85–89.) Field information is presented relevant to the evaluation undertaken by Panel 5 of the N.S.R.C. The methods used to obtain the data are briefly described.

SUBSIDIARY APPARATUS

621.3.087.4: 621.395.625.3 **1031**

Instrumentation Wide-Band Magnetic Tape Recording.—J. P. Pritchard. (*Electronic Engng*, Dec. 1960, Vol. 32, No. 398, pp. 762–766.) The development of a recorder with a bandwidth from d.c. to 4 Mc/s is described.

621.3.087.4: 621.395.625.3 **1032**

The Mechanical Considerations of Magnetic Recording Heads.—M. B. Martin. (*J. Brit. Instn Radio Engrs*, Nov. 1960, Vol. 20, No. 11, pp. 877–883.) Manufacturing problems associated with multitrack heads are discussed in relation to the effects of mechanical variations on head performance. Performance criteria are listed.

621.3.087.4 : 621.395.625.3 : 681.142 **1033**

Some Engineering Aspects of Magnetic Tape System Design.—D. W. Willis & P. Skinner. (*J. Brit. Instn Radio Engrs*, Nov. 1960, Vol. 20, No. 11, pp. 867–876.) A system is described for the evaluation of random and transient effects in terms of specific measurements on waveforms generated by standard tapes rather than in terms of dimensional tolerances.

621.3.087.4 : 621.395.625.3 : 681.142 **1034**

A Fast Start/Stop Machine for Handling Magnetic Tape.—W. C. R. Withers. (*J. Brit. Instn Radio Engrs*, Nov. 1960, Vol. 20, No. 11, pp. 857–866. Discussion, pp. 884–885.) The ½-in.-wide tape is handled at a speed of 100 in./sec with start/stop times of 3 msec (referred to 90% of the final speed). The tape loop length is controlled by phototransistors driving an error-correcting servomechanism.

621.3.087.4 : 621.395.625.3 : 681.142 **1035**

The Development of a High-Performance Tape Handler.—H. M. Harrison. (*J. Brit. Instn Radio Engrs*, Nov. 1960, Vol. 20, No. 11, pp. 841–856. Discussion, pp. 884–885.) Magnetic tape 1 in. wide is handled completely 'out of contact' at 200 in./s by means of vacuum techniques. Start, stop and reverse times are better than 5 ms.

621.314.5 : 621.382.3 **1036**

Stabilized Voltage Supplies using Transistors.—J. S. Bell & P. G. Wright. (*Electronic Engng*, Dec. 1960, Vol. 32, No. 394, pp. 758–761.) Two completely transistorized circuits producing ± 300 V d.c. from a 28-V d.c. supply

621.314.63 **1037**

Reverse Characteristics with Surface Breakdown of Silicon p-s_p-n Rectifiers.—O. Jäntsch. (*Z. Naturf.*, April 1960, Vol. 15a, No. 4, pp. 302–307.) The influence of surface recombination on the reverse and breakdown characteristics is investigated. Measurements were made on Si rectifiers with weakly doped diffusion region, which had been exposed to dry nitrogen and oxygen with or without ozone for different lengths of time, with or without heat treatment. For measurements in moist gases see *ibid.*, Feb. 1960, Vol. 15a, No. 2, pp. 141–149.

621.316.721.078.3 : 621.318.381 **1038**

Stabilization of a Magnetic Field by means of a Galvanometer Photocell Assembly.—R. Stefant. (*C. R. Acad. Sci., Paris*, 22nd Feb. 1960, Vol. 250, No. 8, pp. 1453–1455.) Note on the application of a galvanometer/amplifier system [3571 of 1958 (Sauzade)] for magnetic-field stabilization.

TELEVISION AND PHOTOTELEGRAPHY

621.397.13 (43) **1039**

Television in Germany.—R. Möllin. (*J. Telev. Soc.*, July–Sept. 1960, Vol. 9, No. 7, pp. 247–259. Discussion, pp. 259–262.) A survey of the history and present state of the German television network, the studios used and their technical equipment.

621.397.132.001.4 **1040**

Equipment for the Generation of Colour Bars for the N.T.S.C. Standard.—G. Bolle. (*Elektronische Rundschau*, March 1960, Vol. 14, No. 3, pp. 85–86.) See 345 of January.

621.397.331.24 **1041**

Electron-Optical Properties of a Flat Television Picture Tube.—E. G. Ramberg. (*Proc. Inst. Radio Engrs*, Dec. 1960, Vol. 48, No. 12, pp. 1952–1960.) Ray paths and focusing properties are calculated for the deflection and acceleration fields of a flat picture tube with lateral injection similar to that described by Aiken (977 of 1958).

621.397.331.24 **1042**

High-Slope Television Picture Tubes for Low Modulation Voltages.—E. Gundert & H. Lotsch. (*Telefunken Ztg.*, March 1960, Vol. 33, No. 127, pp. 58–65. English summary, pp. 74–75.) The design principles of high-transconductance tubes are reviewed. 39 references.

621.397.331.24 : 621.385.832.032.269.1 **1043**

Focus Reflex Modulation of Electron Guns.—Schlesinger. (See 1052.)

621.397.334 : 621.397.621 **1044**

Beam Indexing Tubes.—I. Macwhirter. (*Wireless World*, Jan. & Feb. 1961, Vol. 67, Nos. 1 & 2, pp. 2–7 & 92–98.) The single-gun picture tube described has none of the deficiencies of the shadow-mask type of tube. The necessary modification of the N.T.S.C. signal is discussed and details are given of a suitable television display unit providing the requisite indexing and synchronization facilities.

621.397.6 (204) **1045**

Equipment for Underwater Television.—K. Schultz. (*VDI Z.*, 21st March 1960, Vol. 102, No. 9, pp. 339–346.) A review of international developments in this field with a description of an underwater trailing unit capable of carrying up to three television cameras and lighting equipment. The depth of submersion is remotely controlled from the ship which tows the equipment.

621.397.62 : 621.396.679.6 **1046**

Television Downlinks: a Survey.—R. J. Slaughter. (*J. Telev. Soc.*, July–Sept. 1960, Vol. 9, No. 7, pp. 288–293.)

TRANSMISSION

621.396.61.029 : 621.391.812.64 **1047**

The Influence of Sunspot Number on Transmitter Power Requirements for H.F. Ionospheric Circuits.—F. T. Knight. (*Proc. Inst. Radio Engrs*, Dec. 1960, Vol. 48, No. 12, pp. 2033–2035.) Formulae are derived for calculating the change in radiated power, as a function of sunspot number, necessary to maintain a constant field strength at a receiver.

VALVES AND THERMIONICS

621.382.23 **1048**

Avalanche Breakdown in a Diode with a Limited Space-Charge Layer.—Z. S. Gribnikov. (*Fiz. Tverdogo Tela*, May 1960, Vol. 2, No. 5, pp. 854–856.) Estimation of the lowering of the breakdown voltage in a diode with closely spaced rectifying and ohmic contacts, assuming that the ionization coefficients of carriers depend strongly on the field.

621.382.23 : 621.373.029.65 **1049**

Millimetre-Wave Esaki-Diode Oscillators.—C. A. Burrus. (*Proc. Inst. Radio Engrs*, Dec. 1960, Vol. 48, No. 12, p. 2024.) Performance data are given for Esaki diodes made by electrically 'forming' a point contact between Zn and heavily doped n-type GaAs. Maximum power obtained was 25 μW at 50 Gc/s, falling to 2 μW at 90 Gc/s. See also 359 of January (Trambarulo & Burrus).

621.382.23 : 621.375.9 : 621.372.44 **1050**

Noise-Figure Measurements Relating the Static and Dynamic Cut-Off Frequencies of Parametric Diodes.—C. R. Boyd. (*Proc. Inst. Radio Engrs*, Dec. 1960, Vol. 48, No. 12, pp. 2019–2020.) Measurements have been made at about 0·2 Gc/s with a number of Ge and Si diffused-junction mesa-type diodes. A quantitative correspondence between experimental and analytical behaviour is evident and a static-to-dynamic-cut-off frequency ratio of 10 is indicated.

621.385.832.032.26 : 621.317.444 **1051**

Investigation of Focusing Magnets.—Arnaud & Cahen. (See 1001.)

621.385.832.032.269.1 : 621.397.331.24 **1052**

Focus Reflex Modulation of Electron Guns.—K. Schlesinger. (*J. Telev. Soc.*, July–Sept. 1960, Vol. 9, No. 7, pp. 265–271.) Source focusing by electron lens, and modulation from low drive signals by electron reflection, are incorporated in an advanced c.r.-tube gun design. See also 3128 of 1959.

621.387 : 621.362 **1053**

Effect of Magnetic Fields on Thermionic Power Converters.—Schock. (See 1008.)

621.387 : 621.362 **1054**

Effect of Interelectrode Spacing on Cesium Thermionic Converter Performance.—Hatch. (See 1010.)

Abstracts and References

COMPILED BY THE RADIO RESEARCH ORGANIZATION OF THE DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH AND PUBLISHED BY ARRANGEMENT WITH THAT DEPARTMENT

The abstracts are classified in accordance with the Universal Decimal Classification. They are arranged within broad subject sections in the order of the U.D.C. numbers, except that notices of book reviews are placed at the ends of the sections. U.D.C. numbers marked with a dagger (†) must be regarded as provisional. The abbreviations of journal titles conform generally with the style of the World List of Scientific Periodicals. An Author and Subject Index to the abstracts is published annually; it includes a list of journals abstracted, the abbreviations of their titles and their publishers' addresses. Copies of articles or journals referred to are not available from Electronic Technology. *Application must be made to the individual publishers concerned.*

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ACOUSTICS AND AUDIO FREQUENCIES

534.232-14 1055

Bubble Transducer for Radiating High-Power Low-Frequency Sound in Water.—C. C. Sims. (*J. acoust. Soc. Amer.*, Oct. 1960, Vol. 32, No. 10, pp. 1305–1308.) "The bubble transducer consists of a conventional low-impedance electrodynamic driver with an air-filled rubber membrane, or 'bubble', of adjustable volume over the diaphragm. The system at resonance produces large volume displacement of the water with small linear diaphragm displacement at frequencies below 200 c/s. For constant diaphragm volume velocity, the addition of the resonating bubble increases the power output by a factor of approximately 1 000."

534.285.6: 538.6 1056

On the Theory of Ultrasonic Absorption of Metals in a Strong Magnetic Field: Part 1.—E. A. Kaner. (*Zh. eksp. teor. Fiz.*, Jan. 1960, Vol. 38, No. 1, pp. 232–238.) The absorption coefficient is calculated combining closed electron orbits and an arbitrary law of electron dispersion.

534.414.6 1057

Determination of Ultrasonic Velocities by Measurement of Angles of Total Reflection.—W. R. Wilcox. (*J. acoust. Soc. Amer.*, Oct. 1960, Vol. 32, No. 10, pp. 1213–1215.) The method is based on the total reflection of a sound beam from a liquid/solid boundary. The velocity of longitudinal and shear waves in the solid are determined by locating the angles of maximum reflection in the liquid.

534.75 1058

On the Pitch of Periodic Pulses.—J. L. Flanagan & N. Guttman. (*J. acoust. Soc. Amer.*, Oct. 1960, Vol. 32, No. 10, pp. 1308–1319.) "Subjects adjusted the frequency of one periodic pulse train to match the pitch of another train fixed in frequency. Two modes of pitch perception are found. In the first mode, for pulse rates less than 1000/sec, the pulse trains are ascribed a pitch equal to the number of pulses per second, regardless of the polarity pattern of the pulses. In the second mode, for fundamental frequencies in excess of 200 c/s, the stimuli are assigned a pitch equal to the fundamental frequency."

534.75 1059

Pitch of Periodic Pulses without Fundamental Components.—J. L. Flanagan & N. Guttman. (*J. acoust. Soc. Amer.*, Oct. 1960, Vol. 32, No. 10, pp. 1319–1328.) See 1058 above. With filtered pulses a third mode of pitch perception is identified at fundamental frequencies above 1 kc/s.

534.71 1060

Measured Temporal Masking Investigated by Binaural Interaction.—N. Guttman, W. A. van Bergeijk & E. E. David, Jr. (*J. acoust. Soc. Amer.*, Oct. 1960, Vol. 32, No. 10, pp. 1329–1336.)

534.78: 534.88 1061

A Versatile Method for Short-Term Spectrum Analysis in Real Time.—J. S. Gill. (*Proc. Instn. Elect. Engrs.*, Jan. 1961, Vol. 108, No. 47M, pp. 107–116.) A method is outlined for the spectrum analysis of speech as it proceeds in time. Examples are given of continuous spectrograms obtained in an analysis covering a frequency band of 3·3 kc/s, with different analyser bandwidths down to 50 c/s.

534.79 1062

Binaural Summation of Loudness.—G. S. Reynolds & S. S. Stevens. (*J. acoust. Soc. Amer.*, Oct. 1960, Vol. 32, No. 10, pp. 1337–1344.)

681.84 1063

Recording and Reproducing Equalization for Constant and Fine-Groove Records.—P. J. Cox. (*Electronic Engng.*, Jan. 1961, Vol. 33, No. 395, pp. 9–13.) The definitions of the standard characteristics are explained and the effects of generator and load impedances are discussed.

AERIALS AND TRANSMISSION LINES

621.315.212: 621.372.11 1064

A Convenient Transformer for Matching Coaxial Lines.—D. Brandwein. (*Electronic Engng.*, Jan. 1961, Vol. 33, No. 395, pp. 60–66.) Two short sections of the lines to be joined are connected between the lines in such a way that the three impedance changes cancel at a particular frequency.

621.372.2: 621.372.832.45 1065

Recent Advances in the Use of Coupled Transmission Lines as Direct-

Coaxial Couplers.—S. Ruthe. (*Proc. Instn elect. Engrs*, Part B, Jan. 1961, Vol. 108, No. 37, pp. 120–124.) Two designs of slot-coupled coaxial lines in which the slot spacing can be varied have been developed as power monitors and variable attenuators at frequencies up to 7 kMc/s.

621.372.22:621.11 **1066**

Calculations on Lines with Continuously Variable Impedance.—A. V. J. Martin & F. J. Young. (*J. Phys. Radium*, July 1956, Vol. 19, Supplément au No. 7, *Phys. appl.*, pp. 65A–70A.) Two methods are proposed for calculating the impedance of a tapered transmission line: (*a*) by solution of differential equations, giving the impedance as a function of line length for a fixed frequency; (*b*) by successive approximations, considering the line as a series of short sections each having a constant impedance.

621.372.8.049 **1067**

Waveguide Techniques.—O. Heuke & G. Strecker. (*Frequenz*, March 1960, Vol. 14, No. 3, pp. 94–104.) Various techniques of manufacturing waveguides are discussed in relation to size and accuracy requirements as dictated by type of application and operating conditions.

621.372.825 **1068**

Characteristics of Ridge Waveguides.—F. Young & J. Hohmann. (*Appl. sci. Res.*, 1960, Vol. B8, No. 4, pp. 321–336.) General expressions for the parameters of single and double ridged waveguides are derived. Detailed curves for their values are given for waveguides having width/height ratios of 1:1 and 2:1.

621.372.832.8 **1069**

The Microwave Circulator.—E. Pivit & W. Stösser. (*Frequenz*, March 1960, Vol. 14, No. 3, pp. 77–84.) The operating principles of the various types of circulator are summarized, and the theory of the phase-shift type is considered in detail in order to evaluate the tolerances of the constituent elements. Design data and characteristics of phase-shift circulators are given for various frequency ranges.

621.396.674-428 **1070**

Spiral Antennas.—W. L. Curtis. (*Trans. Inst. Radio Engrs*, May 1960, Vol. AP-8, No. 3, pp. 298–306. Abstract, *Proc. Inst. Radio Engrs*, Aug. 1960, Vol. 48, No. 8, p. 1512.)

621.396.674-428 **1071**

The Archimedean Two-Wire Spiral Antenna.—J. A. Kaiser. (*Trans. Inst. Radio Engrs*, May 1960, Vol. AP-8, No. 3, pp. 312–323. Abstract, *Proc. Inst. Radio Engrs*, Aug. 1960, Vol. 48, No. 8, p. 1512.)

621.396.674.3 **1072**

Transient Phenomena associated with Sommerfeld's Horizontal Dipole Problem.—H. J. Frankena. (*Appl. sci. Res.*, 1960, Vol. B8, No. 4, pp. 357–368.) A theoretical treatment gives expressions for the travelling wave from a horizontal dipole having a moment varying arbitrarily with time and situated above a dielectric interface.

621.396.674.2 **1073**

Radiation of Pulses Generated by a Vertical Electric Dipole above a Plane, Conducting Earth.—A. T. de Hoop & H. J. Frankena. (*Appl. sci. Res.*, 1960, Vol. B8, No. 4, pp. 369–377.) An expression is obtained for the e.m. field in air. The reflected-wave portion is expressed as an integral which can be evaluated numerically.

621.396.677–621.397.61 **1074**

The Use of a Slightly Directive Transmitting Aerial in a Populous Area.—G. D. Monteath, G. H. Millard & D. J. Whyte. (*Proc. Instn elect. Engrs*, Part B, Jan. 1961, Vol. 108, No. 37, pp. 65–74.) A review of the problems encountered in providing a satisfactory service using an eight-tier aerial in an urban area, with particular reference to the Crystal Palace station.

621.396.677.3 **1075**

Determination of the Gain and Directional Characteristics of a Yagi Aerial for Decimetre Waves.—D. Stahl. (*Rundfunktech. Mitt.*, April 1960, Vol. 4, No. 2, pp. 85–87.) The optimum arrangement of transmitting and receiving aerials for the measurement of gain and the determination of polar diagrams is shown and results of measurements on four Yagi aerials for use at 569 Mc/s are given.

621.396.677.3 **1076**

A New Mathematical Approach for Linear Array Analysis.—D. K. Cheng & M. T. Ma. (*Trans. Inst. Radio Engrs*, May 1960, Vol. AP-8, No. 3, pp. 255–259. Abstract, *Proc. Inst. Radio Engrs*, Aug. 1960, Vol. 48, No. 8, p. 1511.)

621.396.677.3 **1077**

Log Periodic Dipole Arrays.—D. E. Isbell. (*Trans. Inst. Radio Engrs*, May 1960, Vol. AP-8, No. 3, pp. 260–267. Abstract, *Proc. Inst. Radio Engrs*, Aug. 1960, Vol. 48, No. 8, p. 1511.)

621.396.677.3:523.164 **1078**

The Crossed-Grating Interferometer: a New High-Resolution Radio Telescope.—W. N. Christiansen, N. R. Labrum, K. R. McAlister & D. S. Mathewson. (*Proc. Instn elect. Engrs*, Part B, Jan. 1961, Vol. 108, No. 37, pp. 48–58.) A description of a radio telescope, operating at 21 cm λ, with two ground arrays each consisting of 32 paraboloid aerials spaced uniformly along a 1 200-ft baseline. Details are given of its operation in measuring the brightness distribution of the solar disk.

621.396.677.3:621.396.677.71 **1079**

Mutual Coupling Effects in Large Antenna Arrays: Part I—Slot Arrays.—S. Edelberg & A. A. Oliner. (*Trans. Inst. Radio Engrs*, May 1960, Vol. AP-8, No. 3, pp. 286–297. Abstract, *Proc. Inst. Radio Engrs*, Aug. 1960, Vol. 48, No. 8, p. 1512.)

621.396.677.3:621.396.965 **1080**

Mutual-Impedance Effects in Large Beam Scanning Arrays.—P. S. Carter, Jr. (*Trans. Inst. Radio Engrs*, May 1960, Vol. AP-8, No. 3, pp. 276–285. Abstract, *Proc. Inst. Radio Engrs*, Aug. 1960, Vol. 48, No. 8, pp. 1511–1512.)

621.396.677.8 **1081**

Plane Scattering Cones of Long Wire Antennas.—M. Leitner. (*Trans. Inst. Radio Engrs*, May 1960, Vol. AP-8, No. 3, pp. 266–275. Abstract, *Proc. Inst. Radio Engrs*, Aug. 1960, Vol. 48, No. 8, p. 1511.)

621.396.677.71 **1082**

Coupled Loaded Dipoles: One and Two Parallel Slits in a Plane.—S. Yoshida. (*Trans. Inst. Radio Engrs*, May 1960, Vol. AP-8, No. 3, pp. 333–336. Abstract, *Proc. Inst. Radio Engrs*, Aug. 1960, Vol. 48, No. 8, p. 1512.)

621.396.677.83 **1083**

Experimental Study of a Diffraction Reflector.—J. H. Provencher. (*Trans. Inst. Radio Engrs*, May 1960, Vol. AP-8, No. 3, pp. 331–336. Abstract, *Proc. Inst. Radio Engrs*, Aug. 1960, Vol. 48, No. 8, p. 1512.)

621.396.677.833:523.164 **1084**

Malvern 65-ft Radio Telescope.—J. S. Hey & V. A. Hughes. (*J. Instn elect. Engrs*, Jan. 1961, Vol. 7, No. 73, pp. 7–11.) The precision of construction of the telescope for cm-λ observations is discussed and radio-astronomy applications are outlined.

621.396.677.833.2 **1085**

On the Beam Deviation Factor of a Parabolic Reflector.—Y. T. Lo. (*Trans. Inst. Radio Engrs*, May 1960, Vol. AP-8, No. 3, pp. 347–349.)

AUTOMATIC COMPUTERS

681.142 **1086**

Computer-Generated Displays.—R. T. Loewe, R. L. Sisson & P. Horowitz. (*Proc. Inst. Radio Engrs*, Jan. 1961, Vol. 49, No. 1, pp. 185–195.) A survey of methods and techniques in the presentation of computer outputs. 52 references.

681.142:538.221:539.23 **1087**

Magnetic Film Memory Design.—J. I. Raffel, T. S. Crowther, A. H. Anderson & T. O. Herndon. (*Proc. Inst. Radio Engrs*, Jan. 1961, Vol. 49, No. 1, pp. 155–164.) A storage system for 32 ten-bit words has been operated successfully in the destructive mode with a minimum cycle time of 0·4 μs.

681.142:621.3.087.4:621.395.625.3 **1088**

High-Density Digital Magnetic Recording Techniques.—Hoagland & Bacon. (See 1316.)

681.142:621.318.4 **1089**

The Simulation of Neutral Elements by Electrical Networks Based on Multi-aperture Magnetic Cores.—A. E. Brain. (*Proc. Inst. Radio Engrs*, Jan. 1961, Vol. 49, No. 1, pp. 49–52.) The basic operations of multilevel storage, gating, controlling threshold level, and summation are common to many simulating networks and can be attained by use of multi-aperture magnetic cores.

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A Computer Subsystem using Kilomegacycle Subharmonic Oscillators.—[illegible] (*Proc. Inst. Radio Engrs*, Jan. 1961, Vol. 49, No. 1, pp. 128–135.) A phase-locked oscillator is described which operates at 1.45 Gc/s and has a logical operation time of 11 ns.

681.142: 621.374.4: 621.382.23 **1093**

Frequency Division by Carrier Storage.—Ryan. (See 1107.)

681.142: 621.374.5 **1094**

Computer Memories: a Survey of the State-of-the-Art.—J. A. Rajchman. (*Proc. Inst. Radio Engrs*, Jan. 1961, Vol. 49, No. 1, pp. 104–127.)

681.142: 621.382.23 **1095**

A Survey of Tunnel-Diode Digital Techniques.—R. C. Sims, E. R. Beck, Jr, & V. C. Kamm. (*Proc. Inst. Radio Engrs*, Jan. 1961, Vol. 49, No. 1, pp. 136–146.)

681.142: 621.382.23 **1096**

Calculated Waveforms for Tunnel-Diode Locked Pair.—H. R. Kaupp & D. R. Crosby. (*Proc. Inst. Radio Engrs*, Jan. 1961, Vol. 49, No. 1, pp. 146–154.) The phase-locked pair functions, as a computer element, in a similar manner to that of a phase-locked harmonic oscillator, and also requires a three-phase power supply. Its main advantages are high gain and high transition speed.

CIRCUITS AND CIRCUIT ELEMENTS

621.3.011.22: 621.38 **1097**

The Negative-Resistance Concept in Modern Electronics.—G. D. Sims & I. M. Stephenson. (*J. Electronics Control*, Nov. 1960, Vol. 9, No. 5, pp. 349–383.) A survey with particular reference to the operation of semiconductor diodes and microwave valves.

621.318.57: 621.372.44: 681.142 **1098**

Nonstationary Parametrons.—K. Onose. (*Rev. elect. Commun. Lab., Japan*, May/June 1960, Vol. 8, Nos. 5/6, pp. [illegible]

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621.372.61 **1100**

Observations of some Theorems for Linear Passive Networks.—F. Gasparini. (*Alta Frequenza*, Feb. 1960, Vol. 29, No. 1, pp. 50–95.) An extension of Cohn's theorem for linear passive two-poles [see e.g. 3056 of 1957 (Yeaman)] is proposed facilitating the determination of energy relations in such networks.

621.372.413 **1101**

Theory of Forced Oscillations in Electromagnetic Cavities, and the Equivalent Circuit of a Cavity 2-n-Pole.—H. J. Butterweck. (*Arch. elekt. Übertragung*, March 1960, Vol. 14, No. 3, pp. 101–114.) The e.m. field inside an excited cavity coupled to a two-way transmission line is calculated on the basis of a series expansion of arbitrary vector fields in cavity resonators in terms of orthogonal eigenfunctions. The equivalent circuit derived consists of an infinite number of lumped elements; approximation formulae for practical application are given.

621.372.413: 537.311.33 **1102**

The Cylindrical TE_{11}-Mode Cavity including a Semiconductor Sample with Tensorial Electrical Conductivity.—N. Watanabe. (*Rev. elect. Commun. Lab., Japan*, May/June 1960, Vol. 8, Nos. 5/6, pp. 256–265.) The impedance matrix and characteristic *S*-matrix are derived for two configurations of the input guides. One case is suitable for the measurement of *Hall mobility*, and for the other the proper conditions for use as an isolator are investigated.

621.372.512 **1103**

Iterative Networks as Coupling Networks in Oscillator Circuits.—R. Paul. (*Frequenz*, March 1960, Vol. 14, No. 3, pp. 84–94.) The conditions for self-oscillation are established for valve and transistor oscillators. The characteristics of iterative networks consisting of purely resistive and reactive elements are summarized, and their application in valve and transistor oscillators is investigated. Formulae are given for operating parameters and are verified experimentally.

621.372.543.2 **1104**

Explicit Formulae for the Calculation of the Characteristic Function of Filters with Tchebycheff Pass-Band Behaviour.—A. Fettweis. (*Rev. HF, Brussels*, 1960, Vol. 4, No. 12, pp. 263–271. In English.)

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621.374.4: 621.382.23: 681.142 **1107**

Frequency Division by Carrier Storage.—W. D. Ryan. (*Electronic Engng*, Jan. 1961, Vol. 33, No. 395, pp. 40–41.) A circuit using a junction diode with forward bias that produces output pulses at half the frequency of a 30-kc/s input sinusoidal voltage is described. Possible computer applications are noted.

621.374.4+621.376.233].029.65 **1108**

A Harmonic Generator and Detector for the Short-Millimetre-Wave Region.—H. W. de Wijn. (*Appl. sci. Res.*, 1960, Vol. B8, No. 4, pp. 261–264.) The construction of an instrument of the open-crystal type is described.

621.375.9: 621.372.44 **1109**

Amplification by means of Nonlinear Reactances.—G. B. Stracca & A. Butti. (*Ricerca sci.*, March 1960, Vol. 30, No. 3, pp. 313–343.) The theory of parametric amplification is considered on the basis of the Manley-Rowe power relations. The properties of varactors and their use in parametric amplifiers are discussed; some experimental results are given.

621.375.9: 621.372.44 **1110**

Experimental Demonstration of Parametric Amplification.—E. Meyer & W. Eisenmenger. (*Z. Phys.*, 4th April 1960, Vol. 158, No. 4, pp. 379–385.) Simple experiments are described to demonstrate the basic principles of parametric amplification, (*a*) using a variable-capacitance circuit, and (*b*) by means of a mechanical system for setting up waves on a water surface.

621.375.9: 621.372.44: 621.372.632 **1111**

Noise Figure and Gain of Parametric Converters.—H. Heffner & G. Wade. (*J. appl. Phys.*, Dec. 1960, Vol. 31, No. 12, p. 2316.) A correction is given for a term in a noise-figure equation for a parametric frequency converter given in an earlier communication (77 of 1959).

621.375.9: 621.372.44: 621.385.6 **1112**

An Electron-Beam Parametric Amplifier for the 200-Mc/s Region.—Chalk. (See 1370.)

621.375.9: 621.383: 535.376 **1113**

Power Amplifiers based on Electro-optical Effects; a Survey.—G. Diemer & J. G. van Santen. (*Philips Res. Rep.*, Aug.

1960, Vol. 15, No. 4, pp. 368–389.) The gain, bandwidth, and noise factor of electroluminescent-photoconductive transducers are considered, taking into account the effects of feedback and matching. Suggested practical applications of single and cascade devices are discussed. See 442 of 1960 (Lochinger & Strutt).

621.375.9.029.64: 537.311.33 **1114**

Instability Effects in a Semiconductor Amplifier with Negative Effective Carrier Mass.—A. L. Zakarov. (*Zh. eksp. teor. Fiz.*, Feb. 1960, Vol. 38, No. 2, pp. 665–667.) Critical comment on the proposal of Krömer (1824 of 1959).

621.376.22: 621.374.43 **1115**

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GENERAL PHYSICS

535.325: 535.14 **1116**

Theory of the Complex Refractive Index.—C. A. Mead. (*Phys. Rev.*, 1st Nov. 1960, Vol. 120, No. 3, pp. 854–859.) A quantum-mechanical formalism is developed for representing the complex refractive index of a gas. See also 2690 of 1958.

537.311.1 **1117**

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537.311.62: 538.569.4 **1118**

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537.533 **1119**

The Passage of Electrons through a Rectangular Potential Barrier with a Small Cylindrical Inhomogeneity.—N. B. Alzenberg. (*Fiz. Tverdogo Tela*, June 1960, Vol. 2, No. 6, pp. 1178–1185.) A treatment of the tunnel effect in electron emission by first-order perturbation theory.

537.56 **1120**

On Certain Special Features of Ohmic Heating of an Electron Gas in a Plasma.—A. V. Gurevich. (*Zh. eksp. teor. Fiz.*, Jan. 1960, Vol. 38, No. 1, pp. 116–121.) An investigation of ohmic heating in a constant field, taking account of inelastic collisions, shows that the electron temperature may be in a steady state only for low values of electric field intensity. See also 2532 of 1959.

537.56 **1121**

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537.56: 538.56 **1122**

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537.56: 538.56 **1123**

A Note on "Effects of Relatively Strong Fields on the Propagation of E.M. Waves through a Hypersonically Produced Plasma".—J. M. Fiskin & W. B. Sisco. (*Trans. Inst. Radio Engrs*, May 1960, Vol. AP-8, No. 3, pp. 338–339.) See 454 of 1960 (Sisco & Fiskin).

537.56: 538.56 **1124**

A Note on the Relation between the 'Exact' and 'Simplified' Theories for E.M. Wave Propagation in Ionized Gases.—J. M. Anderson. (*Trans. Inst. Radio Engrs*, May 1960, Vol. AP-8, No. 3, pp. 337–338.) Comment on, and correction to the paper by Sisco & Fiskin (454 of 1960).

537.56: 538.569.4 **1125**

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537.56: 538.63 **1126**

Plasma Oscillations in a Magnetic Field.—I. Kaji & M. Kito. (*J. phys. Soc. Japan*, Oct. 1960, Vol. 15, No. 10, pp. 1851–1861.) A theoretical treatment of longitudinal electron oscillations.

537.56: 538.63 **1127**

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538.311: 530.12 **1128**

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538.566: 535.42 **1129**

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538.566: 535.42 **1130**

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538.566: 535.43 **1131**

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538.566: 537.56: 621.375.9 **1132**

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538.569.2 **1133**

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538.569.4: 535.33: 621.375.9 **1134**

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538.569.4: 538.222 **1135**

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538.569.4: 538.222 **1136**

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538.633 **1137**

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539.2: 537.122 **1138**

Spin Susceptibility of an Electron Gas.—P. A. Wolff. (*Phys. Rev.*, 1st Nov. 1960, Vol. 120, No. 3, pp. 814–819.) The generalized random-phase approximation is used to investigate the effects of electron-electron interaction on the spin susceptibility of an electron gas.

539.2: 548.0 **1139**

Electron Levels in a One-Dimensional Random Lattice.—H. L. Frisch & S. P. Lloyd. (*Phys. Rev.*, 15th Nov. 1960, Vol. 120, No. 4, pp. 1175–1189.)

GEOPHYSICAL AND EXTRATERRESTRIAL PHENOMENA

523.152.3: 538.12 **1140**

Apparent Steady Component of the Interplanetary Magnetic Field.—V. A. Bailey. (*Nature, Lond.*, 7th Jan. 1961, Vol. 189, No. 4758, pp. 44–45.) Arguments based on the results of Coleman et al. (see 3832 of 1960) and on the direction and sense of terrestrial storm fields show that the apparent steady component of the interplanetary field (also known as quiet-time field) is probably directed from the north to the south of the ecliptic.

523.16 **1141**

Existence of Net Electric Charges on Stars.—L. Oster & K. W. Philip: V. A. Bailey. (*Nature, Lond.*, 7th Jan. 1961, Vol. 189, No. 4758, pp. 43–44.) Comment on 2324 of 1960 and author's reply.

523.164: 551.510.535 **1142**

Cosmic Noise Absorption Measurements at Stanford, California, and Pullman, Washington.—B. Lusignan. (*J. geophys. Res.*, Dec. 1960, Vol. 65, No. 12, pp. 3895–3902.) The absorption was measured at 27·5 Mc/s using a riometer. After making allowances for the diurnal variations due to absorption in the D and F layers, a residual diurnal variation remains which has not yet been explained.

523.164: 621.396.677.3 **1143**

The Crossed-Grating Interferometer: a new High-Resolution Radio Telescope.—Christiansen, Labrum, McAlister & Mathewson. (See 1078.)

523.164: 621.396.677.833 **1144**

Malvern 45-ft Radio Telescope.—Hey & Hughes. (See 1084.)

523.164.3 **1145**

A Survey of Radio Stars at a Frequency of 38 Mc/s.—G. R. Whitfield. (*Mon. Not. R. astr. Soc.*, 1960, Vol. 120, No. 6, pp. 581–588.) "This paper describes a survey of small diameter radio stars made with an interferometer at 38 Mc/s. The positions and flux densities of 59 radio stars, all of which are confirmed by other surveys, are given in the catalogue."

523.164.3: 523.75 **1146**

Relation of Jupiter's Radio Emission at Long Wavelengths to Solar Activity.—J. W. Warwick. (*Science*, 28th Oct. 1960, Vol. 132, No. 3435, pp. 1250–1252.) Observations at Boulder during the period January–June 1960 show a strong positive correlation between Jupiter's emission in the range 15–34 Mc/s and solar continuum emission. The time delay of one to two days indicates that fast solar particles at velocities of about $0{\cdot}1c$ may be involved in the planet's atmosphere or magnetic field. See also 523 of February (Carr et al.).

523.164.32: 551.510.535 **1147**

Solar Radio Emission on Centimetre Waves and Ionization of the E Layer of the Ionosphere.—M. R. Kundu. (*J. geophys. Res.*, Dec. 1960, Vol. 65, No. 12, pp. 3903–3907.) The correlation coefficient relating solar r.f. noise flux on wavelengths between 3 and 70 cm to daily and monthly E-layer indices described by Minnis & Bazzard (3281 of 1959 and 1580 of 1960) has been calculated. The coefficient lies in the range 0·7–0·8 for wavelengths between 3 and 30 cm; above 50 cm it falls to 0·2.

523.165: 551.507.362 **1148**

Radiation Environment in Space.—H. E. Newell & J. E. Naugle. (*Science*, 18th Nov. 1960, Vol. 132, No. 3438, pp. 1465–1472.) Summary of information on radiations in space obtained by means of satellites and space probes.

523.165: 551.507.362 **1149**

Relation between Results of Measurements of Charged Particles by means of Traps on Soviet Cosmic Rockets and Measurements of the Magnetic Field on the American Satellite Explorer VI and the Rocket Pioneer V.—K. I. Gringauz & S. M. Rytov. (*Dokl. Ak. Nauk S.S.S.R.*, 1st Nov. 1960, Vol. 135, No. 1, pp. 48–51.) Results of measurements carried out by different methods on the Soviet rockets indicate the existence of a geomagnetic belt of charged particles 60 000 km from the centre of the earth.

523.3: 621.396.96 **1150**

Moon Reflection Studies with Bistatic Radar at 3 000 Mc/s.—A. W. Straiton & C. W. Tolbert. (*Commun. & Electronics*, Sept. 1960, No. 50, pp. 436–440. Discussion.) The reception at Austin, Texas, of moon echoes of transmissions from Malvern, England, is reported. Discrete 'spike' echoes persisted for about 0·25 sec. Simultaneous observations at Malvern and Austin, show no correlation between individual spikes. This is interpreted in terms of an undulating lunar surface.

523.53: 621.396.96 **1151**

Radio Echo Measurements of the Orbits of Faint Sporadic Meteors.—J. G. Davies & J. C. Hill. (*Mon. Not. R. astr. Soc.*, 1960, Vol. 121, No. 5, pp. 437–462.) A survey has shown that many such meteors move in orbits of very short period. The more eccentric orbits are near the plane of the ecliptic but some are circular and have inclinations near 60°. The significance of the results is discussed.

523.53: 621.396.96: 535.42 **1152**

The Calculation of Meteor Velocities from Continuous-Wave Radio Diffraction Effects from Trails.—J. S. Mainstone. (*Mon. Not. R. astr. Soc.*, 1960, Vol. 120, No. 6, pp. 517–529.) Meteor velocities are calculated from the time interval between c.w. echo maxima or minima. Neglect of the initial phase relation between echo and ground wave introduces large errors. An analytical method is described and preliminary results are given.

523.755 **1153**

The Structure and Magnetic Field of the Solar Corona.—J. A. Högbom. (*Mon. Not. R. astr. Soc.*, 1960, Vol. 120, No. 6, pp. 530–539.) Radio observations in 1958 of the Crab nebula made at 38 Mc/s using four interferometers are described. Anisotropic spreading of the source occurred as it passed near the sun. Radial filamentary irregularities of ionization extending out to 30 solar radii are deduced.

550.385: 539.16 **1154**

Possible Magnetic Effects with High-Altitude Explosions of Atomic Bombs.—O. I. Leipunskii. (*Zh. eksp. teor. Fiz.*, Jan. 1960, Vol. 38, No. 1, pp. 302–304.) The effects of a dense diamagnetic plasma expanding in the earth's magnetic field are discussed with reference to the periodic magnetic disturbances associated with the Argus experiment.

550.385.4: 523.75 **1155**

An Approximate Method of Estimating the Size and Shape of the Stationary Hollow Carved Out in a Neutral Ionized

1960, Vol. 15, No. 4, pp. 368–389.) The gain, bandwidth, and noise factor of electroluminescent-photoconductive transducers are considered, taking into account the effects of feedback and matching. Suggested practical applications of single and cascade devices are discussed. See 442 of 1960 (Lochinger & Strutt).

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537.56: 538.56 **1122**

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537.56: 538.56 **1124**

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537.56: 538.63 **1126**

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538.566: 537.56: 621.375.9 **1132**

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539.2: 537.122 **1138**

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GEOPHYSICAL AND EXTRATERRESTRIAL PHENOMENA

523.152.3: 538.12 **1140**

Apparent Steady Component of the Interplanetary Magnetic Field.—V. A. Bailey. (*Nature, Lond.*, 7th Jan. 1961, Vol. 189, No. 4758, pp. 44–45.) Arguments based on the results of Coleman et al. (see 3832 of 1960) and on the direction and sense of terrestrial storm fields show that the apparent steady component of the interplanetary field (also known as quiet-time field) is probably directed from the north to the south of the ecliptic.

523.16 **1141**

Existence of Net Electric Charges on Stars.—L. Oster & K. W. Philip: V. A. Bailey. (*Nature, Lond.*, 7th Jan. 1961, Vol. 189, No. 4758, pp. 43–44.) Comment on 2324 of 1960 and author's reply.

523.164: 551.510.535 **1142**

Cosmic Noise Absorption Measurements at Stanford, California, and Pullman, Washington.—B. Lusignan. (*J. geophys. Res.*, Dec. 1960, Vol. 65, No. 12, pp. 3895–3902.) The absorption was measured at 27·5 Mc/s using a riometer. After making allowances for the diurnal variations due to absorption in the D and F layers, a residual diurnal variation remains which has not yet been explained.

523.164: 621.396.677.3 **1143**

The Crossed-Grating Interferometer: a new High-Resolution Radio Telescope.—Christiansen, Labrum, McAlister & Mathewson. (See 1078.)

523.164: 621.396.677.833 **1144**

Malvern 45-ft Radio Telescope.—Hey & Hughes. (See 1084.)

523.164.3 **1145**

A Survey of Radio Stars at a Frequency of 38 Mc/s.—G. R. Whitfield. (*Mon. Not. R. astr. Soc.*, 1960, Vol. 120, No. 6, pp. 581–588.) "This paper describes a survey of small diameter radio stars made with an interferometer at 38 Mc/s. The positions and flux densities of 59 radio stars, all of which are confirmed by other surveys, are given in the catalogue."

523.164.3: 523.75 **1146**

Relation of Jupiter's Radio Emission at Long Wavelengths to Solar Activity.—J. W. Warwick. (*Science*, 28th Oct. 1960, Vol. 132, No. 3435, pp. 1250–1252.) Observations at Boulder during the period January–June 1960 show a strong positive correlation between Jupiter's emission in the range 15–34 Mc/s and solar continuum emission. The time delay of one to two days indicates that fast solar particles at velocities of about $0{\cdot}1c$ may be involved in the planet's atmosphere or magnetic field. See also 523 of February (Carr et al.).

523.164.32: 551.510.535 **1147**

Solar Radio Emission on Centimetre Waves and Ionization of the E Layer of the Ionosphere.—M. R. Kundu. (*J. geophys. Res.*, Dec. 1960, Vol. 65, No. 12, pp. 3903–3907.) The correlation coefficient relating solar r.f. noise flux on wavelengths between 3 and 70 cm to daily and monthly E-layer indices described by Minnis & Bazzard (3281 of 1959 and 1580 of 1960) has been calculated. The coefficient lies in the range 0·7–0·8 for wavelengths between 3 and 30 cm; above 50 cm it falls to 0·2.

523.165: 551.507.362 **1148**

Radiation Environment in Space.—H. E. Newell & J. E. Naugle. (*Science*, 18th Nov. 1960, Vol. 132, No. 3438, pp. 1465–1472.) Summary of information on radiations in space obtained by means of satellites and space probes.

523.165: 551.507.362 **1149**

Relation between Results of Measurements of Charged Particles by means of Traps on Soviet Cosmic Rockets and Measurements of the Magnetic Field on the American Satellite Explorer VI and the Rocket Pioneer V.—K. I. Gringauz & S. M. Rytov. (*Dokl. Ak. Nauk S.S.S.R.*, 1st Nov. 1960, Vol. 135, No. 1, pp. 48–51.) Results of measurements carried out by different methods on the Soviet rockets indicate the existence of a geomagnetic belt of charged particles 60 000 km from the centre of the earth.

523.3: 621.396.96 **1150**

Moon Reflection Studies with Bistatic Radar at 3 000 Mc/s.—A. W. Straiton & C. W. Tolbert. (*Commun. & Electronics*, Sept. 1960, No. 50, pp. 436–440. Discussion.) The reception at Austin, Texas, of moon echoes of transmissions from Malvern, England, is reported. Discrete 'spike' echoes persisted for about 0·25 sec. Simultaneous observations at Malvern and Austin, show no correlation between individual spikes. This is interpreted in terms of an undulating lunar surface.

523.53: 621.396.96 **1151**

Radio Echo Measurements of the Orbits of Faint Sporadic Meteors.—J. G. Davies & J. C. Hill. (*Mon. Not. R. astr. Soc.*, 1960, Vol. 121, No. 5, pp. 437–462.) A survey has shown that many such meteors move in orbits of very short period. The more eccentric orbits are near the plane of the ecliptic but some are circular and have inclinations near 60°. The significance of the results is discussed.

523.53: 621.396.96: 535.42 **1152**

The Calculation of Meteor Velocities from Continuous-Wave Radio Diffraction Effects from Trails.—J. S. Mainstone. (*Mon. Not. R. astr. Soc.*, 1960, Vol. 120, No. 6, pp. 517–529.) Meteor velocities are calculated from the time interval between c.w. echo maxima or minima. Neglect of the initial phase relation between echo and ground wave introduces large errors. An analytical method is described and preliminary results are given.

523.755 **1153**

The Structure and Magnetic Field of the Solar Corona.—J. A. Högbom. (*Mon. Not. R. astr. Soc.*, 1960, Vol. 120, No. 6, pp. 530–539.) Radio observations in 1958 of the Crab nebula made at 38 Mc/s using four interferometers are described. Anisotropic spreading of the source occurred as it passed near the sun. Radial filamentary irregularities of ionization extending out to 30 solar radii are deduced.

550.385: 539.16 **1154**

Possible Magnetic Effects with High-Altitude Explosions of Atomic Bombs.—O. I. Leipunskii. (*Zh. eksp. teor. Fiz.*, Jan. 1960, Vol. 38, No. 1, pp. 302–304.) The effects of a dense diamagnetic plasma expanding in the earth's magnetic field are discussed with reference to the periodic magnetic disturbances associated with the Argus experiment.

550.385.4: 523.75 **1155**

An Approximate Method of Estimating the Size and Shape of the Stationary Hollow Carved Out in a Neutral Ionized

Streams of Corpuscles Impinging on the Geomagnetic Field.—V. C. A. Ferraro. (*J. geophys. Res.*, Dec. 1960, Vol. 65, No. 12, pp. 3951–3955.) A two-dimensional case is considered in which the permanent field is due to a current acting perpendicular to the stream. The breadth of the hollow at infinity is shown to be finite.

550.380 **1156**

The Latitudinal Distribution of Magnetic Activity in Canada.—K. Whitham, J. S. Loomer & J. R. Totten. (*J. geophys. Res.*, Dec. 1960, Vol. 65, No. 12, pp. 3961–3976.) Measurements of the hourly ranges in the principal horizontal field component at 16 Canadian (U.S.) stations are described. A narrow zone or area of enhanced magnetic activity exists at high latitudes with a maximum near Alert, $\phi = 86°$. The seasonal and diurnal variations of magnetic activity at different latitudes are also considered.

551.507.362.2 **1157**

Perturbations of the Orbit of the Echo Balloon.—I. I. Shapiro & M. Ol. Jones. (*Science*, 16th Nov. 1960, Vol. 132, No. 3438, pp. 1484–1486.) Predictions of the influence of solar radiation pressure are confirmed by the changes in orbit of satellite 1960 ι_2 during the first 12 days after its launching.

551.507.362.2 **1158**

Observed Solar Pressure Perturbations of Echo I.—D. O. Muhleman, R. H. Hudson, D. B. Holdridge, R. L. Carpenter & K. C. Oslund. (*Science*, 18th Nov. 1960, Vol. 132, No. 3438, p. 1487.) A decrease in perigee height of 3·0 km/day and an increase in the eccentricity of 0·00038 per day were observed during the first 10 days after launching of 1960 ι_2. See also 1157 above.

551.507.362.2 : 621.317.361 **1159**

A Method for Interpreting the Doppler Curves of Artificial Satellites.—G. Boudouris. (*J. Brit. Instn Radio Engrs*, Dec. 1960, Vol. 20, No. 12, pp. 933–935.) A graphical-analytical method for determining the point of inflexion and the maximum slope is explained in detail. See also 1601 of 1960 (Boudouris et al.).

551.507.362.2 : 621.391.812.3 **1160**

Irregular Fading of Satellite Transmissions.—W. C. Bain. (*Nature, Lond.*, 14th Jan. 1961, Vol. 189, No. 4759, p. 129.) The distribution of the mean scintillation index with magnetic inclination, derived from observations at Slough of 20-Mc/s transmissions from 1959 ι_2 is discussed in relation to comments by Mawdsley (4215 of 1960) on a paper by Kent.

551.507.362.2 : 621.391.812.3 **1161**

Sudden Amplitude Variations of Sputnik III Signals.—H. Whitney, H. Strick, J. Aarons & J. Mott. (*J. geophys. Res.*, Dec. 1960, Vol. 65, No. 12, pp. 4210–4212.) Two distinct causes of 'drop-outs' in the signal received from 1958 δ2 are identified: (*a*) a change in transmitter characteristics, and (*b*) a localized absorbing or scattering region in the ionosphere.

551.507.362.2 : 621.391.812.63 **1162**

Field-Aligned Ionospheric Irregularities and the Scintillation of Satellite Radio Transmissions.—D. G. Singleton, G. H. Lynch & J. A. Thomas. (*Nature, Lond.*, 7th Jan. 1961, Vol. 189, No. 4758, pp. 30–31.) Observations of radio transmissions from 1958 δ_2 made at Brisbane during July–September 1960 have been analysed. Results indicate that the scintillation activity associated with propagation along the lines of the earth's magnetic field is more pronounced than that associated with other directions of propagation. The results are in agreement with those of Rush & Cohn (Proc. Inst. Radio Engrs, Jan. 1958, Vol. 46, No. 1, pp. 330–331).

551.507.362.2 : 621.396.81 **1163**

Radar Echoes observed from Sputnik Satellites 1957 Alpha and 1957 Beta.—W. E. Jaye, R. B. Dyce & R. L. Leadabrand. (*Planet. Space Sci.*, Jan. 1961, Vol. 5, No. 1, pp. 39–58.) Observations at Stanford, California, using a 106-Mc/s radar with a 0·04 steradian paraboloid are described. Echoes from 1957 α and β were seen on 58 occasions. The echoes usually lasted about 60 sec as the satellite crossed the aerial beam. Cyclic fading at 0·1–0·9 c/s occurred, usually with constant polarization and attributable to satellite tumbling. On one occasion 1957 β passed within 200 km of an auroral disturbance detected on the radar; large amplitude fluctuations were seen and the echo lasted longer than usual.

551.510.535 **1164**

Structure of the Thermosphere.—M. Nicolet. (*Planet. Space Sci.*, Jan. 1961, Vol. 5, No. 1, pp. 1–32.) The vertical distribution of density in the thermosphere as deduced from satellite observations is examined and it is shown that the varying scale-height gradient is due to a decrease in the molecular weight of the atmospheric constituents. The temperature of the night-time isothermal atmosphere and the distribution of scale height in the sunlit atmosphere is related to the ultraviolet heating available during the day. 87 references.

551.510.535 **1165**

Origin of the D Region.—E. C. Y. Inn. (*Planet. Space Sci.*, Jan. 1961, Vol. 5, No. 1, pp. 76–78.) The *D* region may result from the ionization, by Lyman alpha radiation, of O_2 molecules in an excited state. The mechanism for the excitation of the O_2 molecules is discussed.

551.510.535 **1166**

Anisotropy in Ionospheric Diffraction and its Effect on Drift Measurement.—R. B. Banerji. (*Proc. phys. Soc.*, 1st Dec. 1960, Vol. 76, No. 492, pp. 959–968.) A method of analysis is developed in which five statistical parameters and a few simple formulae are used, and which takes into account the effects of random motion as well as anisotropy.

551.510.535 **1167**

Lunar Tide in the F_2 Layer of the Ionosphere near the Geomagnetic Equator.—R. G. Rastogi. (*Nature, Lond.*, 21st Jan. 1961, Vol. 189, No. 4760, pp. 214–215.) Lunar variations of f_0F_2 at Ahmedabad during the period November 1958–October 1959 are analysed and compared with those for other low-latitude stations. Results suggest that stations having the same magnetic latitude rather than the same geomagnetic latitude experience similar variations of f_0F_2, the one 900 of March (Sanchez & Titheridge).

551.510.535 **1168**

Spread-F and Obliquity Scattering in the Ionosphere.—D. G. Singleton. (*J. geophys. Res.*, Dec. 1960, Vol. 65, No. 12, pp. 3921–3926.) The occurrence of spread-F is examined statistically. A model is derived based on the assumption of radio reflexions in the underside of the F layer under equinoctial conditions, and is applied in detail to a typical example of spread-F.

551.510.535 : 523.75 **1169**

Enhancement of Ionization in the E Layer due to Solar Flares during the International Geophysical Year.—G. H. Stazzard. (*Nature, Lond.*, 7th Jan. 1961, Vol. 189, No. 4758, pp. 47–48.) The value of f_0E observed at Slough at the hour preceding the commencement of each flare of importance 2+ and 3 and at the two succeeding hours have been examined in relation to normal values. Results show that during the interval 25–120 min after the commencement of a flare there is a mean increase in the intensity of E-layer ionizing radiation which is at least 22% for class 3 flares and 8% for class 2+ flares.

551.510.535 : 551.594.6 **1171**

Spread-F and the Latitude Variation of Occurrence of Whistlers.—D. G. Singleton. (*Nature, Lond.*, 21st Jan. 1961, Vol. 189, No. 4760, pp. 215–216.) An explanation of the latitude variation of whistler activity based on propagation within field-aligned ducts [2753 of 1960 (Smith et al.)] is consistent with current ideas for interpreting spread-F echoes [see e.g. 1737 of 1958 (Briggs)].

551.510.535 : 621.391.812.63 **1172**

On the Generalization of the Appleton-Hartree Magneto-ionic Formulas.—Sen & Wyller. (See 1296.)

551.510.535(98) : 621.391.812.631 **1173**

The Polar Radio Black-Out of the Ionosphere of 7 July, 1958.—J. H. Chapman. (*Canad. J. Phys.*, Sept. 1960, Vol. 38, No. 9, pp. 1195–1212.) Ionospheric data are used to study the polar-cap absorption effects occurring in both hemispheres after the 3+ flare on 7th July. It is suggested that electrons first precipitated to the highest latitudes and then protons and helium ions to lower latitudes.

551.594.6 **1177**

Recent Results in the Investigation of the Relation between Lightning Discharges and Whistlers.—H. Norinder & E. Knudsen. (*Planet. Space Sci.*, Jan. 1961, Vol. 5, No. 1, pp. 46–49.) Harmonic analysis shows that lightning discharges which produce whistlers have a pronounced energy peak near 5 kc/s. Multiple whistlers are caused by multiple discharges through the same lightning channel. See also 2383 of 1960.

LOCATION AND AIDS TO NAVIGATION

621.396.933.23 **1178**

The Problem of Improving the British Instrument Landing System Localizer for Automatic Landing.—A. N. Beresford & J. D. Asteraki. (*Proc. Instn elect. Engrs*, Part B, Jan. 1961, Vol. 108,

535.215: 546.48'221 **1193**

Photoconductivity Mechanism in CdS-Type Single Crystals.—M. K. Sheinkman. (*Fiz. Tverdogo Tela*, June 1960, Vol. 2, No. 6, pp. 1155–1159.) An analysis of experimental data based on the exciton hypothesis.

535.215: 546.48'221 **1194**

Investigation of the Kinetics of Infrared Impurity Photoconductivity in CdS, Induced by Preliminary Illumination.—E. N. Arkad'eva, L. G. Paritskil & S. M. Ryvkin. (*Fiz. Tverdogo Tela*, June 1960, Vol. 2, No. 6, pp. 1160–1168.) Investigation of the photoconductivity of CdS crystals at 77°K in the infrared region from 2 to 4 μ produced by pre-excitation due to illumination at a wavelength corresponding to the intrinsic absorption. A model for the infrared photoconductivity is discussed, based on the transition of electrons to the conduction band from trapping levels which are filled with electrons resulting from the preliminary illumination.

535.37: 546.48'221 **1195**

Polarization of the Edge Emission in CdS.—R. J. Collins & J. J. Hopfield. (*Phys. Rev.*, 1st Nov. 1960, Vol. 120, No. 3, pp. 840–842.)

535.376 **1196**

(Zn,Hg)S and (Zn,Cd,Hg)S Electroluminescent Phosphors.—A. Wachtel. (*J. electrochem. Soc.*, Aug. 1960, Vol. 107, No. 8, pp. 682–688.) Procedures for the preparation of solid solutions of cubic (Zn,Hg)S and (Zn,Cd,Hg)S by firing in sealed silica tubes are described. With suitable additions of Cu as activator and of halides, Ga, or In as coactivator, photoluminescence and electroluminescence have been obtained. The electroluminescence at the red end of the spectrum consists of two emission bands which do not appear to be analogous to the blue and green emission bands of Cu,Cl in ZnS.

535.376: 546.47'221 **1197**

Electrical Properties of Electroluminescent ZnS Powders.—R. Goffaux. (*J. Phys. Radium*, April 1959, Vol. 20, Supplement to No. 4, *Phys. appl.*, pp. 18A–22A.) The properties of ZnS powder have been discussed and interpreted with the aid of varistor theory. The layer impedance may be represented by a variable resistance R_p in parallel with a variable capacitance C_p. An interpretation of the variation of R_p and C_p with voltage has been developed from previous work on varistors subjected to an alternating voltage (3135 of 1958): experimental results are in good agreement with this interpretation.

535.376: 546.681'17 **1198**

Luminescence and Photoconductivity Properties of Doped GaN.—H. G. Grimmeiss, R. Groth & J. Maak. (*Z. Naturf.*, Sept. 1960, Vol. 15a, No. 9, pp. 799–806.) Similarities with the characteristics of ZnS-type phosphors were found.

537.226: 621.396.677.85 **1199**

Some Theoretical Investigations on Metal-Disc Delay Dielectrics.—S. K. Chatterjee & C. Dhanalakshmi. (*J. Instn Telecommun. Engrs, India*, June 1960, Vol. 6, No. 4, pp. 149–152.) The phase-shift suffered by a plane e.m. wave passing through an array of metal disks is calculated. The dielectric constant of the medium is also found.

537.226.2 **1200**

Measurement of Complex Dielectric Constant of Rochelle Salt at a Frequency of 10 Gc/s as a Function of Temperature and Electrical Bias Voltage.—W. Jäckle. (*Z. angew. Phys.*, April 1960, Vol. 12, No. 4, pp. 148–155.)

537.227 **1201**

Electro-optical Kerr Effect and Polarization Reversal in Deuterium-Doped Rochelle Salt.—H. H. Wieder & D. A. Collins. (*Phys. Rev.*, 1st Nov. 1960, Vol. 120, No. 3, pp. 725–730.) Polarization reversal as a function of nucleation and growth of domains in ferroelectric deuterium-doped Rochelle salt was investigated by means of the Kerr effect.

537.227: 537.5 **1202**

High-Temperature Discharges in Ferroelectric Ceramics.—J. W. Northrip. (*J. appl. Phys.*, Dec. 1960, Vol. 31, No. 12, pp. 2293–2296.) An experimental investigation is described of the properties of a temperature-dependent current discharge seen in disks of $BaTiO_3$ and $Pb(Zr,Ti)O_3$. This discharge, which is largest between 300 and 600°C, and falls off exponentially with time, depends primarily on the electrode material and its application. An explanation is proposed in terms of solid-state chemical activity.

537.227: 546.431'824-31 **1203**

Aging of Barium Titanate Single Crystals.—A. Misarova. (*Fiz. Tverdogo Tela*, June 1960, Vol. 2, No. 6, pp. 1276–1282.) Description of measurements of the changes of permittivity, tan δ, the hysteresis loop and the conductivity of $BaTiO_3$ single crystals during aging, with and without a constant electric field. A hypothesis analogous to that of Müser (3008 of 1959) is proposed to explain the aging process.

537.311.31: 538.63 **1204**

The Relation between the Temperature Dependence of Electrical Resistance at Low Temperatures and the Galvanomagnetic Effect in Strong Magnetic Fields.—O. S. Galkina & L. A. Chernikova. (*Zh. eksp. teor. Fiz.*, Jan. 1960, Vol. 38, No. 1, pp. 3–6.) Results of measurements on Ni-Cu alloys support the assumption that the change in electrical resistance is due to the scattering of conduction electrons by the inhomogeneities in lattice magnetization.

537.311.33 **1205**

Determination of Carrier Mobility and Density in the Surface Layer of a Semiconductor.—V. K. Subashiev & S. A. Poltinnikov. (*Fiz. Tverdogo Tela*, June 1960, Vol. 2, No. 6, pp. 1169–1177.) Two methods are described for determining the surface carrier density and mobility of a semiconductor layer formed by impurity diffusion. The methods are based on Hall-effect and conductivity data and the relation between carrier mobility and density. Results of diffusion-layer measurements on Si photocells are given.

537.311.33 **1206**

Optical Absorption and Recombination Radiation in Semiconductors due to Transitions between Hydrogen-Like Acceptor Impurity Levels and the Conduction Band.—D. M. Eagles. (*J. Phys. Chem. Solids*, Nov. 1960, Vol. 16, Nos. 1/2, pp. 76–83.) A simplified theory is given of the expected form of the absorption and radiation spectra. Necessary modifications are discussed and comparison made with experimental observations.

537.311.33 **1207**

Impurity Conduction at Low Concentrations.—A. Miller & E. Abrahams. (*Phys. Rev.*, 1st Nov. 1960, Vol. 120, No. 3, pp. 745–755.) The conductivity of an *n*-type semiconductor has been calculated in the region of low temperature and low impurity conduction using the model of phonon-induced 'hopping' of electrons from donor site to donor site. The results are in satisfactory agreement with experiment.

537.311.33 **1208**

Filled and Empty Dangling Bonds in III-V Compounds.—D. B. Holt. (*J. appl. Phys.*, Dec. 1960, Vol. 31, No. 12, pp. 2231–2232.) Introduction of the idea of resonance to a model of dangling bonds which is free from the objections to the previous model [1693 of 1960 (Gatos et al.)].

537.311.33: 538.569.4 **1209**

Properties of Semiconductors with an Extremum Loop: Part 1—Cyclotron and Combinational Resonance in a Magnetic Field Perpendicular to the Plane of the Loop.—É. I. Rashba. (*Fiz. Tverdogo Tela*, June 1960, Vol. 2, No. 6, pp. 1224–1238.) Investigation of the absorption of radio waves in semiconductors having a specific band structure in which an extremum is reached not at isolated points but over a curve in **k**-space. As a result of spin-orbit coupling, transitions involving a change in spin due to the Lorentz force are significantly strong.

537.311.33: 546.23 **1210**

The Hole Mobility in Selenium.—W. E. Spear. (*Proc. phys. Soc.*, 1st Dec. 1960, Vol. 76, No. 492, pp. 826–832.) At 20°C the effective hole mobility of vitreous Se lies between 0·13 and 0·14 $cm^2/V.sec$ and its temperature dependence shows it to be controlled by a level of acceptor states lying 0·14 eV above the valence band. The above values are similar to those for single crystals of hexagonal Se, suggesting a common controlling mechanism.

537.311.33: 546.24 **1211**

Some Effects occurring in Dislocated Tellurium.—J. S. Blakemore, J. W. Schultz & K. C. Nomura. (*J. appl. Phys.*, Dec. 1960, Vol. 31, No. 12, pp. 2226–2231.)

537.311.33: 546.26-1: 538.63 **1212**

de Haas-van Alphen Effect in Graphite between 3 and 85 Kilogauss.—W. J. Spry & P. M. Scherer. (*Phys. Rev.*, 1st Nov. 1960, Vol. 120, No. 3, pp. 826–829.)

537.311.33: 546.28 **1213**

Visible Light Emission and Microplasma Phenomena in Silicon *p-n* Junction: Part 2—Classification of Weak Spots in Diffused *p-n* Junctions.—M. Kikuchi. (*J. phys. Soc. Japan*, Oct. 1960, Vol. 15, No. 10, pp. 1822–1831.) Two groups of weak spots exist; one type shows microplasma current pulses at certain bias voltages and the other type contributes a 'soft' component to the reverse current. Typical experimental results are given. Part 1: 4294 of 1960 (Kikuchi & Tachikawa).

537.311.33: 546.28 **1214**

The Identification of Precipitate Particles in Single Crystals of Silicon by Reflection Electron Diffraction.—R. C. Newman. (*Proc. phys. Soc.*, 1st Dec. 1960, Vol. 76, No. 492, pp. 993–996.)

537.311.33: 546.28 **1215**

Spin-Lattice Relaxation of Donor Electrons in Silicon.—J. Kondo. (*Progr. theor. Phys.*, July 1960, Vol. 24, No. 1, pp. 161–170.) The relaxation rate is calculated using an adiabatic approximation.

537.311.33: 546.28 **1216**

Interstitial *versus* Substitutional Oxygen in Silicon.—W. L. Bond & W. Kaiser. (*J. Phys. Chem. Solids*, Nov. 1960, Vol. 16, Nos. 1/2, pp. 44–45.) "Lattice constant and density studies on oxygen free and oxygen doped silicon single crystals suggest that oxygen occupies an interstitial lattice site."

537.311.33: 546.28 **1217**

Gold-Induced Climb of Dislocations in Silicon.—W. C. Dash. (*J. appl. Phys.*, Dec. 1960, Vol. 31, No. 12, pp. 2275–2283.)

537.311.33: 546.281'26 **1218**

Nonlinear Properties and Ionic Migration of Silicon Carbide.—R. Goffaux. (*Rev. gén Élect.*, June 1960, Vol. 69, No. 6, pp. 331–338.) Experimental results are interpreted by a hypothesis in which mobile ions are held in intergrain boundaries by the field of surface-adsorbed charges and move under the influence of temperature or electric field. See also 3135 of 1958.

537.311.33: 546.289 **1219**

Hot Carriers in Germanium.—B. V. Rollin & J. M. Rowell. (*Proc. phys. Soc.*, 1st Dec. 1960, Vol. 76, No. 492, pp. 1001–1002.) Experiments on the variation of Hall mobility with lattice temperature and incident radiation are described.

537.311.33: 546.289 **1220**

Investigations of Wetting and Alloying on Germanium.—M. Michelitsch. (*Z. angew. Phys.*, April 1960, Vol. 12, No. 4, pp. 180–184.) The difficulties of wetting and alloying In and In alloys with *n*-type Ge, and means of overcoming them, are investigated.

537.311.33: 546.289 **1221**

Evaluation and Control of Diffused Impurity Layers in Germanium.—H. S. Veloric & W. J. Greig. (*RCA Rev.*, Sept. 1960, Vol. 21, No. 3, pp. 437–456.) A new solid-phase diffusion process with powdered Ge alloy of known impurity concentration is evaluated. Experiments show that the surface concentration of added impurities can be estimated from the impurity concentration in the source Ge powder.

537.311.33: 546.289 **1222**

Thermal Conductivity of Germanium from 3°K to 1 020°K.—G. A. Slack & C. Glassbrenner. (*Phys. Rev.*, 1st Nov. 1960, Vol. 120, No. 3, pp. 782–789.)

537.311.33: 546.289 **1223**

Low-Temperature Transport in 'Split *p*-Germanium'.—S. H. Koenig & J. J. Hall. (*Phys. Rev. Lett.*, 15th Dec. 1960, Vol. 5, No. 12, pp. 550–553.) Measurements of conductivity and Hall mobility in Ge crystals, at temperatures below 10°K and under large shear strains, give information concerning deformation potentials, and velocity dependence of the recombination cross-section.

537.311.33: 546.289 **1224**

Valley-Orbit Splitting of Antimony in Germanium.—H. Fritzsche. (*Phys. Rev.*, 15th Nov. 1960, Vol. 120, No. 4, pp. 1120–1124.) The electrical conductivity of Sb-doped Ge has been measured in single crystals subjected to stress. The valley-orbit splitting was thereby deduced to be about 0·57 meV.

537.311.33: 546.289 **1225**

Infrared Investigation of the Acceptor Levels formed by Copper in Germanium.—D. L. Greenaway. (*Proc. phys. Soc.*, 1st Dec. 1960, Vol. 76, No. 492, pp. 900–908.) Measurements between 1 and 34 μ indicate that the three acceptor levels introduced can be identified by their effect on the low-temperature absorption spectra of suitably doped samples.

537.311.33: 546.289 **1226**

Note on Semiconductor Statistics.—S. Teitler & R. F. Wallis. (*J. Phys. Chem. Solids*, Nov. 1960, Vol. 16, Nos. 1/2, pp. 71–75.) The Guggenheim method using the grand partition function is applied to multilevel impurities in Ge.

537.311.33: 546.289 **1227**

Electrical Properties of Heavily Doped *n*-Type Germanium.—Y. Furukawa. (*J. phys. Soc. Japan*, Oct. 1960, Vol. 15, No. 10, pp. 1903–1904.) The electron concentration in four crystals doped with both As and Sb has been compared with resistivity. *I/V* characteristics of Esaki diodes made with the material have been studied.

537.311.33: 546.289 **1228**

The Diffusion of Hydrogen in Single-Crystal Germanium.—R. C. Frank & J. E. Thomas, Jr. (*J. Phys. Chem. Solids*, Nov. 1960, Vol. 16, Nos. 1/2, pp. 144–151.) Permeation rates and diffusion coefficients were measured between 800 and 910°C.

537.311.33: 546.289-31 **1229**

Donor Equilibria in the Germanium-Oxygen System.—C. S. Fuller, W. Kaiser & C. D. Thurmond. (*J. Phys. Chem. Solids*, Nov. 1960, Vol. 16, Nos. 1/2, pp. 161–163.) Experimental results show agreement with theory revised to include the effect of intrinsic carrier concentration.

537.311.33: 546.47'86 **1230**

Anisotropy of Certain Electrical Properties of Single Crystals of Zinc Antimonide.—M. V. Kot & I. V. Kretsu. (*Fiz. Tverdogo Tela*, June 1960, Vol. 2, No. 6, pp. 1250–1255.) Methods of preparation of single crystals of ZnSb are outlined and measurements of their electrical properties are reported. The crystals show *p*-type conductivity and anisotropy in their electrical properties.

537.311.33: 546.48-31: 539.23 **1231**

The Relations between the Optical Absorption and Dispersion and the Conductivity Mechanism of Thin Cadmium Oxide Films.—H. Finkenrath. (*Z. Phys.*, 12th April 1960, Vol. 158, No. 5, pp. 511–532.)

537.311.33: 546.48'86 **1232**

Anisotropy of Electrical Properties of Single Crystals of Cadmium Antimonide.—I. K. Andronik & M. V. Kot. (*Fiz. Tverdogo Tela*, June 1960, Vol. 2, No. 6, pp. 1128–1133.) Methods of preparing single crystals of CdSb are described and the temperature dependence of electrical conductivity, thermal e.m.f. and Hall effect are examined. Crystals have anisotropic electrical properties and the width of the forbidden band is about 0·57 eV.

537.311.33: 546.681'19 **1233**

Space-Charge Currents in Gallium Arsenide.—J. W. Allen & R. J. Cherry. (*Nature, Lond.*, 28th Jan. 1961, Vol. 189, No. 4761, pp. 297–298.) Experimental results are presented confirming the correctness of a model proposed earlier by Allen (3575 of 1960) to account for the properties of semi-insulating GaAs.

537.311.33: 546.681'4'241 **1234**

Effects of Solid Solution of Ga_2Te_3 with $A^{III}B^{VI}$ Tellurides.—J. C. Woolley & B. Ray. (*J. Phys. Chem. Solids*, Nov. 1960, Vol. 16, Nos. 1/2, pp. 102–106.)

537.311.33: 546.681'86 **1235**

Thermomagnetic Properties of Gallium Antimonide.—D. Kh. Amirkhanova. (*Fiz. Tverdogo Tela*, June 1960, Vol. 2, No. 6, pp. 1125–1127.) Investigation of the Nernst-Ettingshausen effects on five *p*-type GaSb specimens in the temperature range 100–900°K.

537.311.33: 546.682'19 **1236**

Voigt Effect in Semiconductors.—S. Teitler & E. D. Palik. (*Phys. Rev. Lett.*, 15th Dec. 1960, Vol. 5, No. 12, pp. 546–548.) The effective electron mass ratio for *n*-type InAs is determined from the magnetic double refraction of 15-μ infrared radiation in fields up to 70 kG.

537.311.33 **1237**
:[546.682'86 + 546.682'19'18

Hall Constant and Electron Mobility of InSb, InAs and $In(As_{1-x}P_{1-x})$ in Strong Magnetic Fields.—E. Braunersreuther, F. Kuhrt & H. J. Lippmann. (*Z. Naturf.*, Sept. 1960, Vol. 15a, No. 9, pp. 795–799.) Measurements were made at field strengths up to 180 kG. The Hall constants of InAs and $In(As_{1-x}P_{1-x})$ were found to be independent of the field; in

InSb the Hall constant dropped with increasing field strength (about 15% at 4·70 kG).

537.311.33: 546.682'86 **1238**

Lattice Absorption Bands in Indium Antimonide.—S. J. Fray, F. A. Johnson & R. H. Jones. (*Proc. phys. Soc.*, 1st Dec. 1960, Vol. 76, No. 492, pp. 939–948.)

537.311.33: 546.682'86 **1239**

Effect of Landau Levels upon Tunnel Currents in Indium Antimonide.—A. G. Chynoweth, R. A. Logan & P. A. Wolff. (*Phys. Rev. Lett.*, 15th Dec. 1960, Vol. 5, No. 12, pp. 548–550.) The tunnel current is observed to decrease in an oscillatory manner, with increase of magnetic field. This effect is attributed to fluctuations in level density at the Fermi surface.

537.311.33: 546.682'86 **1240**

Magnetoresistance of High-Purity InSb in the Quantum Limit.—R. J. Sladek. (*J. Phys. Chem. Solids*, Nov. 1960, Vol. 16, Nos. 1/2, pp. 1–9.) Measurements between 111°K and 50°K with magnetic field strengths up to 28 kG show qualitative agreement with theory for the quantum limit for the case of piezoelectric scattering and classical statistics.

537.311.33: 546.682'86 **1241**

The Galvanomagnetic Properties of InSb Single Crystals with Te Doping.—H. Rupprecht, R. Weber & H. Weiss. (*Z. Naturf.*, Sept. 1960, Vol. 15a, No. 9, pp. 783–794.) Measurements were made on material with Te concentration $>10^{16}$/cm³. The investigations cover the change of resistivity in a magnetic field as a function of doping, crystal orientation, magnetic flux density, and the angle between magnetic flux and current, at 295, 78 and 4·2°K.

537.311.33: 546.682'86'241 **1242**

Some Electrical and Optical Properties of InSb-In_2Te_3 Alloys.—J. C. Woolley, C. M. Gillett & J. A. Evans. (*J. Phys. Chem. Solids*, Nov. 1960, Vol. 16, Nos. 1/2, pp. 138–143.) The range of solid solution at the InSb end of the alloy system has been determined by X-ray methods to be about 15 mol % In_2Te_3, and properties in this range have been investigated.

537.311.33: 546.873'241 **1243**

Theory of Piezoresistance in Bi_2Te_3.—M. I. Klinger. (*Fiz. Tverdogo Tela*, June 1960, Vol. 2, No. 6, pp. 1353–1356.)

537.312.62 **1244**

Magnetic Moment of Transition Metal Atoms in Dilute Solution and their Effect on Superconducting Transition Temperature.—B. T. Matthias, M. Peter, H. J. Williams, A. M. Clogston, E. Corenzwit & R. C. Sherwood. (*Phys. Rev. Lett.*, 15th Dec. 1960, Vol. 5, No. 12, pp. 542–544.) $Mo_{1-x}Re_{x-1}$ alloys show strong lowering of the transition temperature with increasing Fe concentration. The magnetic moment per Fe atom, in Nb-Mo solid solutions increases sharply with increase in Mo concentration.

537.323 **1245**

Thermoelectric Properties of Alloys of the Pseudobinary System Sb_2Te_3-Bi_2Te_3.—G. V. Kokosh & S. S. Sinani. (*Fiz. Tverdogo Tela*, June 1960, Vol. 2, No. 6, pp. 1118–1124.) Investigation of the effect of impurities on solid solutions of semiconductors with disturbed stoichiometry. The effect of firing on the electrical conductivity is examined and the properties of alloys of different purity are compared.

537.327: 534.1 **1246**

Dependence of Mechanical *Q* and Young's Modulus of Ferroelectric Ceramics on Stress Amplitude.—R. Gerson. (*J. acoust. Soc. Amer.*, Oct. 1960, Vol. 32, No. 10, pp. 1297–1301.) Measurements on $BaTiO_3$ and $Pb(Ti,Zr)O_3$ compositions are reported. The mechanical *Q* decreased to about one-third of its low-signal value at a stress of 1 500 lb/in². No further decrease occurred up to 4 000 lb/in². Young's modulus decreased by about 5% in materials used in power transducers, and by about 25% in compositions having low coercive force.

538.22: 537.311.33 **1247**

Electric Conduction in Antiferromagnetics.—G. L. Sewell. (*Proc. phys. Soc.*, 1st Dec. 1960, Vol. 76, No. 492, pp. 985–987.) The mechanism of phonon-induced electron jump is used to explain the anomalous electrical properties of NiO and α-Fe_2O_3.

538.22: 546.824-31 **1248**

Magnetic Susceptibility of Tetragonal Titanium Dioxide.—F. E. Senftle, T. Pankey & F. A. Grant. (*Phys. Rev.*, 1st Nov. 1960, Vol. 120, No. 3, pp. 820–825.) Measured values for the magnetic susceptibility are given as $0{\cdot}067 \times 10^{-6}$ e.m.u./g for a single crystal of high-purity rutile and less than $0{\cdot}02 \times 10^{-6}$ e.m.u./g for anatase powder.

538.22: 546.824'881-31 **1249**

Magnetic Susceptibility of Solid Solutions of Vanadium Dioxide in Titanium Dioxide.—S. M. Ariya & G. Grossmann. (*Fiz. Tverdogo Tela*, June 1960, Vol. 2, No. 6, pp. 1283–1286.) Report of measurements on VO_2-TiO_2 solid solutions prepared by prolonged annealing at 800°C.

538.221 **1250**

Magnetic Viscosity due to Solute Atom Pairs: Part 1—Theory of the Effect.—G. Biorci, A. Ferro & G. Montalenti. (*J. appl. Phys.*, Dec. 1960, Vol. 31, No. 12, pp. 2121–2125.) The additional effect of solute atom pairs in ferromagnetic alloys is explained.

538.221 **1251**

Exchange Anisotropy in Cobalt-Manganese Alloys.—J. S. Kouvel. (*J. Phys. Chem. Solids*, Nov. 1960, Vol. 16, Nos. 1/2, pp. 107–114.)

538.221 **1252**

Time Decrease of Permeability of Substitutional Ferromagnetic Alloys.—C. Kuroda. (*J. phys. Soc. Japan*, Oct. 1960, Vol. 15, No. 10, p. 1898.) Results for Ni-Co alloys are given.

538.221 **1253**

Hall Effect and Resistivity of Ni-Pd Alloys.—J. A. Dreesen & E. M. Pugh. (*Phys. Rev.*, 15th Nov. 1960, Vol. 120, No. 4, pp. 1218–1223.)

538.221: 537.311.31 **1254**

The Electrical-Resistance Maximum for Ferromagnetics at their Curie Points at Low Temperatures.—E. I. Kondorskii, O. S. Galkina & L. A. Chernikova. (*Zh. eksp. teor. Fiz.*, Feb. 1960, Vol. 38, No. 2, pp. 646–648.) Experimental verification of the existence of a resistivity maximum in the region of magnetic saturation for Cu-Ni alloys with Curie point below 20°K.

538.221: 538.632 **1255**

Temperature Dependence of the Hall Effect in Pure Ferromagnetics.—N. V. Volkenshtein & G. V. Fedorov. (*Zh. eksp. teor. Fiz.*, Jan. 1960, Vol. 38, No. 1, pp. 64–67.) Results are given of measurements of the Hall effect in 99·998% pure Fe, Ni and Co from room temperature down to 4·2°K. Present theories are inadequate for an explanation of the experimental data obtained.

538.221: 621.317.441 **1256**

Homogeneous Magnetic Fields for Optical Investigations of Ferromagnetic Specimens.—H. Murrmann & C. Schwink. (*Z. angew. Phys.*, April 1960, Vol. 12, No. 4, pp. 155–157.) The design of solenoids producing uniform magnetic fields and provided with a gap for the observation of specimens being magnetized is discussed.

538.221: 621.318.124 **1257**

The Effect of Cation Vacancies on the Magnetic Annealing of $Co_xFe_{3-x}O_4$.—T. Inoue, H. Mizuta & S. Iida. (*J. phys. Soc. Japan*, Oct. 1960, Vol. 15, No. 10, pp. 1899–1900.) The relaxation time is found to be inversely proportional to the density of cation vacancies in a certain range.

538.221: 621.318.124 **1258**

Numerical Evaluation of Functions occurring in a Study of Domain Configuration in Thin Layers of $BaFe_{12}O_{19}$.—A. J. W. Duijvestijn & B. P. A. Boonstra. (*Philips Res. Rep.*, Aug. 1960, Vol. 15, No. 4, pp. 390–393.) Graphs are presented showing the variation of $(h_1 + h_2)$ as a function of ν, and $N(\mu,\delta)$ as a function of α. See 2845 of 1960 (Kooy & Enz).

538.221: 621.318.132 **1259**

Contribution of Dislocations to the Initial Susceptibility of Magnetically Soft Material.—G. Rieder. (*Z. Naturf.*, Aug. 1960, Vol. 15a, No. 8, pp. 746–748.) Note on the theory of magnetization reversal in weak fields with regard to the effect of dislocations on the deformation of Bloch walls. See 2467 of 1960.

538.221: 621.318.134 **1260**

Contribution to the Experimental Investigation of the Properties of certain Ferrites in the 10-Gc s Band.—V. Cagan. (*Ann. Phys., Paris*, Sept.-Oct. 1960, Vol. 5, Nos. 9/10, pp. 1301–1354.) Detailed report of Faraday-effect and

resonance measurements relating to the development of low-loss ferrites. 52 references.

538.221 : 621.318.134 **1261**

The Statistics of Superexchange Interaction and Ionic Distribution in Substituted Ferrimagnetic Rare-Earth Iron Garnets.—S. Geller. (*J. Phys. Chem. Solids*, Nov. 1960, Vol. 16, Nos. 1/2, pp. 21–29.)

538.221 : 621.318.134 **1262**

Subsidiary Resonance in the Coincidence Region in Yttrium Iron Garnet.—F. C. Rossol. (*J. appl. Phys.*, Dec. 1960, Vol. 31, No. 12, pp. 2273–2275.) Measurements are made of the variation with frequency of h_{min}, the threshold r.f. field for subsidiary resonance, for a single-crystal sphere of Y-Fe garnet. The measured curve, flat from 2 600–3 300 Mc/s, is compared with one computed from Suhl's theory of subsidiary resonance at high power levels (3052 of 1958).

538.221 : 621.318.134 **1263**

On Some Calcium-Iron-Oxygen Compounds.—P. B. Braun & W. Kwestroo. (*Philips Res. Rep.*, Aug. 1960, Vol. 15, No. 4, pp. 394–397.) A description of the preparation and magnetic properties of three new classes of compounds stabilized by the addition of small amounts of a third component.

MATHEMATICS

511 + 513] : 621.396.74 **1264**

The Mathematical Principles Underlying the Theoretical Planning of Transmitter Networks.—Fastert. (See 1310.)

517.564.4 : 537.56 **1265**

Cartesian Tensor Scalar Product and Spherical Harmonic Expansions in Boltzmann's Equation.—T. W. Johnston. (*Phys. Rev.*, 15th Nov. 1960, Vol. 120, No. 4, pp. 1103–1111.)

517.918 **1266**

The Equivalence of the Taylor-Cauchy and Laurent-Cauchy Transform Analysis with Conventional Methods.—E. V. Bohn: A. A. Wolf. (*Proc. Inst. Radio Engrs*, Jan. 1961, Vol. 49, No. 1, pp. 350–361.) Comment on 2853 of 1960 (Ku et al.) and author's reply.

517.949.8 : 517.54 **1267**

Contribution to the Modified Z-Transform Theory.—E. I. Jury. (*J. Franklin Inst.*, Aug. 1960, Vol. 270, No. 2, pp. 114–129.) The complex convolution integral for both the z-transform and modified z-transform are discussed in detail and considered in relation to pulsed systems.

MEASUREMENTS AND TEST GEAR

621.3.018.41 (083.74) : 538.569.4 **1268**

Hyperfine Splitting of Rubidium-87.—L. Essen, E. G. Hope & D. Sutcliffe. (*Nature, Lond.*, 28th Jan. 1961, Vol. 189, No. 4761, p. 298.) Brief note of measurements of the atomic beam value for Rb-87 in a mixture with Cs-133. The value corrected for asymmetry and magnetic field is 6 834 682 614·0 ± 1 c/s.

621.317.3 : 550.372 **1269**

Ground-Constant Measurements using a Section of Balanced Two-Wire Transmission Line.—E. J. Kirkcaldie. (*Trans. Inst. Radio Engrs*, May 1960, Vol. AP-8, No. 3, pp. 307–312. Abstract, *Proc. Inst. Radio Engrs*, Aug. 1960, Vol. 48, No. 8, p. 1512.)

621.317.34 **1270**

Errors due to Losses in Measurements on Balanced Elements.—M. Seidl. (*Alta Frequenza*, Feb. 1960, Vol. 29, No. 1, pp. 50–58.) The errors which affect measurements on balanced circuits by means of baluns in the m-λ range are discussed. Accuracy can be improved by introducing corrections for the losses of the balun based on a modified equivalent circuit. Experimental results are given.

621.317.44 **1271**

Field Measurements by the Method of Harmonics: Methodical Investigations.—J. Greiner. (*NachrTech.*, March 1960, Vol. 10, No. 3, pp. 123–126.) Differences in the characteristics of various types of magnetometer head are considered, and the results of comparative measurements are tabulated. See 2475 of 1960.

621.317.7 : 621.373.42.009.6 **1272**

The Concept of Equivalent Source E.M.F. and Equivalent Available Power in Signal-Generator Calibration.—D. Woods. (*Proc. Instn elect. Engrs*, Part B, Jan. 1961, Vol. 108, No. 37, pp. 37–42.) A discussion of methods of standardizing the output level of signal generators, with special reference to the errors arising from mismatch.

621.317.755 : 621.385.832.032.265 **1273**

Velocity Modulation and Related High-Frequency Deflection Errors of the Travelling-Wave Deflection System.—Goldberg. (See 1378.)

621.317.789.029.63 **1274**

Standardization of Strong Electromagnetic Fields.—J. A. Lane & J. E. Pearson. (*Nature, Lond.*, 7th Jan. 1961, Vol. 189, No. 4758, pp. 49–50.) Brief description of a method for establishing standard flux densities under laboratory conditions at frequencies of the order of 1 Gc/s and input powers of 10–20 W. A TEM-type wave is transmitted between parallel brass plates 3–5 m long, 60 cm wide and 10 cm apart forming a strip-line, terminated in an absorbing load. Absolute values of the flux density in the strip-line may be determined from the voltage induced in a probe which has been calibrated by reference to a rectangular waveguide transmitting an H_{10} wave of known power. Preliminary results suggest an error in measurement of less than ± 1 dB.

621.317.794 : 621.372.822 **1275**

The Design and Performance of Tantalum-Film Bolometers in Rectangular Waveguides.—J. A. Lane & D. M. Evans. (*Proc. Instn elect. Engrs*, Part B, Jan. 1961, Vol. 108, No. 37, pp. 133–135.) Equations are derived which determine the design of film bolometers. Measurements on an improved tunable-type instrument at a wavelength of 3 cm indicate that power levels between 1 and 100 mW can be measured in terms of a d.c. calibration with an error of not more than ± 2%.

621.317.799 : 621.396.62.029.62 **1276**

Artificial Aerials for Measurements on Metre-Wave Receivers.—C. Egidi. (*Tech. Mitt. PTT*, 1st March 1960, Vol. 38, No. 3, pp. 66–101. In Italian and French.) Circuits, equations and tables of parameters are given for measurements with networks designed for coupling one or more signal generators to a receiver under various matching conditions.

OTHER APPLICATIONS OF RADIO AND ELECTRONICS

535.247.4 : 621.385.832.001.4 **1277**

C.R.T. Photonicrometer.—A. Ciuciura. (*Mullard tech. Commun.*, June 1960, Vol. 5, No. 44, pp. 141–158.) Detailed description of an instrument which provides on a pen-recorder chart a light-intensity profile of a line on a c.r. tube raster.

621.362 + 621.56] : 537.322 **1278**

Mathematical Theory of a Peltier-Effect Refrigerator and of a Thermoelectric Generator.—E. B. Penrod & Cho Yen Ho. (*J. Phys. Radium*, July 1960, Vol. 21, Supplement to No. 7, *Phys. appl.*, pp. 97A–112A.)

621.362 : 621.387 **1279**

Potential Distributions in a Low-Pressure Thermionic Converter.—P. L. Auer. (*J. appl. Phys.*, Dec. 1960, Vol. 31, No. 12, pp. 2096–2103.) A plane-diode model of a low-pressure Cs-filled thermionic converter is used for the analysis.

621.362 : 621.387 **1280**

Experimental Investigations of the Cesium Plasma Cell.—W. Ranken, G. M. Grover & E. W. Salmi. (*J. appl. Phys.*, Dec. 1960, Vol. 31, No. 12, pp. 2140–2153.) Evaluation of some aspects of the performance of a Cs plasma cell with Ta emitter, and the effects of Cs vapour pressure, emitter temperature and emitter-collector separation.

621.38 : 551.46.018 **1281**

Electronic Techniques in Oceanography.—M. J. Tucker. (*J. Brit. Instn Radio Engrs*, Dec. 1960, Vol. 20, No. 12,

pp. 921–931.) Underwater acoustics is discussed and a shipborne wave recorder and a Vibrotron f.m. pressure gauge are described.

621.385.8: 77 **1282**

Image Converter Tube for High-Speed Photography.—T. Nakamura & T. Kasai. (*Electronics*, 9th Dec. 1960, Vol. 33, No. 50, pp. 76–78.) Shutter pulses 0·1 μsec wide repeated every 2 μsec combined with electron-beam deflection give a series of displaced images.

621.385.833 **1283**

Small-Angle Diffraction with Electron Beams.—H. Mahl & W. Weitsch. (*Naturwissenschaften*, July 1960, Vol. 47, No. 13, pp. 301–302.) A note on the application of an electron microscope for observations of lattice spacings up to about 1 000 Å.

621.396 **1284**

Analogue Telemetry Equipment and Systems: Part I.—R. E. Young. (*Electronic Engng*, Jan. 1961, Vol. 33, No. 395, pp. 16–20.) An air-to-ground television installation and automatic camera control equipment are described.

PROPAGATION OF WAVES

621.391.812.62: 621.397 **1285**

Weather Conditions during Television Reception from East Germany and Italy.—Braun. (See 1320.)

621.391.812.62.029.45 **1286**

Propagation at 9 600 Mc/s in the Los Angeles Basin.—W. J. Flock, R. C. Mackey & W. D. Hershberger. (*Trans. Inst. Radio Engrs*, May 1960, Vol. AP-8, No. 3, pp. 235–241. Abstract, *Proc. Inst. Radio Engrs*, Aug. 1960, Vol. 48, No. 8, p. 1511.)

621.391.812.63 **1287**

H.F. Propagation—its Present and Future Use for Communication Purposes.—A. F. Wilkins. (*J. Brit. Instn Radio Engrs*, Dec. 1960, Vol. 20, No. 12, pp. 939–951.) The history, current practices, and future trends in long-distance propagation are reviewed. Improved ionospheric predictions are possible by use of an index I_{12} based on f_0F_2, by frequency-sweep, and by back-scatter techniques. Propagation effects on h.f. aerial design, and the use of earth satellites for v.h.f. and u.h.f. communication are mentioned. 28 references.

621.391.812.63 **1288**

Applying the Chordal-Hop Theory of Ionospheric Long-Range Propagation to Echo-Signal Delay.—H. J. Albrecht. (*Proc. Inst. Radio Engrs*, Jan. 1961, Vol. 49, No. 1, pp. 356–357.) Analysis of published time delays of round-the-world echoes shows that the predominant mode of propagation is one in which the waves suffer no ground reflections but are reflected only by the ionosphere.

621.391.812.63 **1289**

On the Effect of a Magnetic Field on the Spectrum of Incoherent Scattering.—T. Laaspere. (*J. geophys. Res.*, Dec. 1960, Vol. 65, No. 12, pp. 3955–3959.) A theoretical analysis of scattering by electrons in the ionosphere neglecting e.s. attraction between electrons and ions. The thermal velocity of the electrons causes them to gyrate about and drift along the magnetic lines. The gyration produces phase modulation of the incident wave giving a line spectrum. The drift velocity blurs the line spectrum if the scattering wave vector is not normal to the lines.

621.391.812.63 **1290**

Scattering of Radio Waves by an Ionized Gas in Thermal Equilibrium.—J. A. Fejer. (*Canad. J. Phys.*, Aug. 1960, Vol. 38, No. 8, pp. 1114–1133.) Expressions for the frequency/power spectrum of waves scattered by density fluctuations are derived and used in the interpretation of results of ionospheric observations of this type of scattering in terms of electron density and temperature. A shortened revised report of this work was noted earlier (10 *J of* January).

621.391.812.63 **1291**

Ship-Distance Sky Focusing in the Ionosphere.—L. Gildea. (*Nature, Lond.*, 7th Jan. 1961, Vol. 189, No. 4758, pp. 40–41.) Observations of ship-distance focusing of 20-Mc/s signals from 1950 are examined and found to be in general agreement with the related theoretical analysis of Bremmer.

621.391.812.63 **1292**

Experimental Proof of Focusing at the Ship Distance by Back-Scatter Records.—H. F. Bates, R. D. Hunsucker & L. Owren. (*Proc. Inst. Radio Engrs*, Jan. 1961, Vol. 49, No. 1, p. 360.) A comment on the distinction between long-time and ship-area focusing (2080 of 1960) and author's reply.

621.391.812.63: 551.76 **1293**

Method of Studying Travel Time Anomalies of High-Frequency Radio Waves.—G. Leifald & F. Schelle. (*Rev. sci. Instrum.*, Dec. 1960, Vol. 31, No. 12, pp. 1309–1311.) A device is described for the automatic measurement of changes in travel time of signals propagated via the ionosphere from station WWV.

621.391.812.63: 551.507.362 **1294**

Doppler Shifts and Faraday Rotation of Radio Signals in a Time-Varying Inhomogeneous Ionosphere: Part I—Single Signal Case.—J. M. Kelso. (*J. geophys. Res.*, Dec. 1960, Vol. 65, No. 12, pp. 3909–3914.) The ionosphere is treated as quasi-isotropic; the ray path is obtained in a manner which is exact in an isotropic medium, but the refractive index is permitted to be a function of ray direction.

621.391.812.63: 551.507.362.2 **1295**

A Reciprocity Theorem for Non-periodic Fields.—G. Goubau. (*Trans. Inst. Radio Engrs*, May 1960, Vol. AP-8, No. 3, pp. 339–342.) Reciprocity in transmission between a satellite and a ground station is considered theoretically and is shown to be invalid due both to gyromagnetic effects in the ionosphere and to the fact that a moving source is involved.

621.391.812.63: 551.510.535 **1296**

On the Generalization of the Appleton-Hartree Magneto-ionic Formulas.—H. K. Sen & A. A. Wyller. (*J. geophys. Res.*, Dec. 1960, Vol. 65, No. 12, pp. 3931–3950.) The Appleton-Hartree formulae are modified by assuming the collision frequency to be dependent on electron velocity. The elements of the generalized conductivity tensor are expressed as integrals which can be evaluated from existing tabulations in the case when the collision frequency is proportional to the square of the velocity. Numerical calculations are given for several cases of longitudinal and transverse propagation, and compared with corresponding Appleton-Hartree results.

621.391.812.8 **1297**

Vertical and Oblique Incidence Series of the C.C.I.R. at Los Angeles, 1958.—A. Gya-bassa. (*Rev. Télécommunications, Madrid*, March 1960, Vol. 15, No. 59, pp. 6–12.) Summary of statements emphasizing the superiority of predictions based on oblique-incidence measurements. A comparison is made between the results of Gya's method (e.g. 1770 of 1960) and those obtained by the Japanese method [735 of 1959 (Miya & Kaneyo)] for the circuit Tokyo–Geneva.

621.391.812.8–621.396.8 **1298**

On Increase of the Limiting Operating Frequencies in Short-Wave Long-Distance Traffic as an Effect of Solar Particle Radiation.—G. Lange-Hesse. (*Arch. elekt. Übertragung*, March 1960, Vol. 14, No. 3, pp. 113–120.) Analysis of observational data obtained at Lindau and Wingst to determine the statistical relation between the geomagnetic activity, used as a measure of solar particle radiation, and the relative deviation of the MUF(3000)F2 factor and (MUF)$_{\text{min}}$ from their median values. A dependence on sunspot cycle and on season is found, and the significance of the results with regard to the prediction of disturbance is discussed.

RECEPTION

621.391.82: 621.396.65 **1299**

Radio-Frequency Interference in Multichannel Telephony F.M. Radio Systems.—R. Hamer. (*Proc. Instn elect. Engrs*, Part B, Jan. 1961, Vol. 108, No. 37, pp. 75–89.) The noise power ratio in the output telephony baseband due to a r.f. interfering signal is derived theoretically, and the results are compared with measured values.

621.396.62.029.62: 621.317.799 **1300**

Artificial Aerials for Measurements on Metre-Wave Receivers.—Egidi. (See 1276.)

621.396.666: 621.396.4 **1301**

Multiple Diversity with Nonindependent Fading.—J. N. Pierce. (*Proc. Inst.*

Radio Engrs, Jan. 1961, Vol. 63, No. 1, pp. 363–364.) The analytical method for determining multiple-diversity system performance, given by Pierce & Stein (1306 of 1960), is illustrated for the special case of binary data transmission by frequency-shift keying.

STATIONS AND COMMUNICATION SYSTEMS

621.376.2 **1305**

A General Theory and Oscilloscopic Study of Single-Sideband Generation by Weaver's Method.—S. Narasimhan. (*J. Instn Telecommun. Engrs, India*, June 1960, Vol. 6, No. 7, pp. 102–106.) Adjustments to Weaver's system (*Proc. Inst. Radio Engrs*, Dec. 1956, Vol. 44, No. 12, pp. 1703–1705) are best made by modulating with a sinusoid, and viewing a few cycles of o.f. on a repetitive timebase. A mathematical analysis of the pattern shapes is given.

621.391 **1306**

Information Theory.—P. Holdsworth & G. F. Jones. (*Electronic Technol.*, Feb. 1961, Vol. 38, No. 2, pp. 49–51.) A detailed introduction with practical examples.

621.391.22 **1307**

Design of the Terminal Equipment for the 12-Ch. a System on Coaxial Pairs.—H. Ogiwa. (*Rev. elect. Commun. Lab., Japan*, May–June 1960, Vol. 8, Nos. 5/6, pp. 390–397.) The equipment for a 12-ch. v.f.-band system is outlined. It may be added to existing 2-ch./3-coax standard coaxial lines.

621.396.1 **1308**

The Economics of Radio Frequencies.—S. Silliver. (*Microwaves*, Feb. 1960, Vol. 29, No. 1, pp. 36–37.) The international regulations regarding frequency allocations are briefly reviewed. Ideal conditions for occupying the radio-frequency spectrum on the basis of various principles of 'sharing' are considered, together with the practical limitation of such arrangements.

621.396.43: 551.507.362.2 **1309**

A Transatlantic Communication Experiment via Echo I Satellite.—H. Carru, R. Gendrin & M. Reynaud. (*Nature, Lond.*, 28th Jan. 1961, Vol. 189, No. 4761, pp. 268–271.) An analysis of the results of an experiment in which c.w. signals transmitted from Holmdel, New Jersey, on a frequency of 960·045 Mc/s were received at Jury-les-Moulineaux, France, after reflection from the satellite 1960 ι.

621.396.65 **1307**

Through-Switching Methods in Radio-Link Relay Stations.—A. Egger. (*Rundfunktech. Mitt.*, April 1960, Vol. 4, No. 2, pp. 80–84.) Block diagrams of switching systems for f.m. links are discussed and the effects on transmission quality and operation of the radio link are considered.

621.396.65 **1308**

Radio Links at Centimetre Wavelengths.—F. Klima & R. Tuhl. (*Radio u. Fernsehen*, March 1960, Vol. 9, No. 5, pp. 141–143.) Details are given of Czech equipment for mobile and fixed installations mainly for use in television links in the 3- and 6-cm bands.

621.396.65: 621.376.34 **1309**

The Multiplexing of Radio Link Systems with Pulse Width Modulation by Frequency Modulation of the R.F. Carrier.—R. Ehrmann. (*Nachr. Tech.*, March 1960, Vol. 10, No. 3, pp. 95–103.) Block diagrams of transmitter and receiver using pulse width modulation with simultaneous frequency modulation of the carrier are given. The effect of f.m. on pulse shape and transmission characteristics is considered.

621.396.70: [133 + 523 **1310**

The Mathematical Principles Underlying the Theoretical Planning of Transmitter Networks.—H. W. Farrer. (*Rundfunktech. Mitt.*, April 1960, Vol. 4, No. 2, pp. 69–76.) Mathematical theory underlying the method given in 757 of February (Klein et al.). Five English versions are *B.B.C. Res.*, April 1960, No. 0106, pp. 60–68.)

621.396.97: 534.76 **1311**

A Compatible Stereophonic System for the U.H.F. Broadcast Band.—J. Veros, S. A. Steinhilber, P. K. Hyde, J. H. O'Connell, J. G. Young & R. V. Rhodes. (*RCA Rev.*, Sept. 1960, Vol. 21, No. 3, pp. 398–416.) Various possible systems are discussed. An axis-free system using a pre-emphasized (left + right) signal to modulate the carrier frequency, with the resultant signal amplitude modulated by the (left + right) signal, was found to be superior.

LABORATORY APPARATUS

621-526: 621.316.2 **1312**

Speed Control of D.C. Motors.—M. J. Miller & G. V. Buckley. (*Electronic Technol.*, Feb. 1961, Vol. 38, No. 2, pp. 63–67.) Two designs of a continuously variable type of servo system are described: the first employs a phase-lock feedback system and the second a simple velocity feedback system.

621-526: 681.142: 621.317.727 **1313**

Multitapped Potentiometers as Accurate Linear Transducers.—K. C. Garner. (*Electronic Engng*, Jan. 1961, Vol. 33, No. 395, pp. 32–35.) A method is given for calculating the shunt resistance values required to compensate for the load error, which enables the potentiometer resistance, the minimum input resistance and the load to be independently specified.

621.3.087.4: 621.395.625.3 :621.318.134 **1314**

Durable High-Resolution Ferrite Transducer Heads employing Bonding Glass Spacers.—S. Duinker. (*Philips Res. Rep.*, Aug.. 1960, Vol. 15, No. 4, pp. 342–367.) The construction is described of various types of ferrocube magnetic recording head which have high resistance to wear and improved signal/noise ratio.

621.3.087.4: 621.395.625.3: 681.142 **1315**

The Development of the Circular-Disk Magnetic Recorder.—R. T. Pearson. (*Proc. Inst. Radio Engrs*, Jan. 1961, Vol. 49, No. 1, pp. 164–174.) The optimum operating conditions for supporting a rotating flexible mylar disk with magnetic coating above a rigid back plate using a gas film are discussed.

621.3.087.4: 621.395.625.3: 681.142 **1316**

High-Density Digital Magnetic Recording Techniques.—A. S. Hoagland & G. C. Bacon. (*Proc. Inst. Radio Engrs*, Jan. 1961, Vol. 49, No. 1, pp. 249–267.) A comprehensive readback simulation computer program is described which will automatically simulate, for any characteristic pulse, all possible readback signal patterns and test them for specified reading logic as a function of bit density.

621.314.63 **1317**

Analysis of the D.C. Characteristic of Selenium Rectifiers.—H. Lanchner. (*J. appl. Phys.*, April 1960, Vol. 11, No. 4, pp. 171–180.) The method of analysis given permits the separation of the various physical phenomena in the rectification process. An empirical equation for a limited section of the rectifier characteristic is derived. The reduction of the slope of the logarithmic I-V characteristic (equal to the fractional value a attributed to the effect of the contact of Se with the n-type intermediate layer of CdSe.

621.316.721.078.2 **1318**

Constant-Current Supply for Very-High-Resistance Loads.—H. W. Hunter. (*Rev. sci. Instrum.*, Dec. 1960, Vol. 31, No. 12, pp. 1297–1298.) Battery-operated transistorized equipment using a Geiger photometer for current control in the range $1 \cdot 10^{-9}$ to 10^{-6} A for any load resistance from zero to $10^{12}\,\Omega$ is described. Measured changes in current with various load conditions do not exceed 1·3%.

681.188: 621.395.625.3.001.4 **1319**

The Testing of Metal Tape Magnetic Cores for Use in a Code Translator.—J. D. Ashbrook. (*Electronic Engng*, Jan. 1961, Vol. 33, No. 395, pp. 21–26.) Acceptance tests are described which simulate the actual conditions under which the cores will be used.

TELEVISION AND PHOTOTELEGRAPHY

621.397: 621.391.812.62 **1320**

Weather Conditions during Television Reception from East Germany and Italy.—G. P. A. Braam. (*Tijdschr. ned. Radiogenoot.*, 1960, Vol. 25, No. 3, pp. 113–129.) The relation between meteorological conditions and the reception of television signals over exceptionally long distances is

investigated. Daily field-strength measurements taken over a period of 8 months are discussed with reference to refractive-index gradients computed from radiosonde observations.

621.397 : 621.391.837.2 **1321**

The Visual Interference Effect of Horizontal Picture Instability in Television.—U. Messerschmid. (*Rundfunktech. Mitt.*, April 1960, Vol. 4, No. 2, pp. 74–79.) Subjective tests were made to assess the interference caused by horizontal oscillations of the picture during transmissions from video tape recordings or in live transmissions with mains-controlled synchronization. The visual effect is most acute at frequencies between 5 and 15 c/s, and the maximum permissible amplitude of horizontal picture displacement is about 0·7 picture elements.

621.397.23 : 534.76 **1322**

Stereophonic System for Television Broadcasting.—R. B. Dome. (*Electronics*, 16th Dec. 1960, Vol. 33, No. 51, pp.71–73.) Design considerations are discussed and details given for a system employing a double sideband with suppressed subcarrier to transmit stereo information.

621.397.331.24 **1323**

Effective Spot Size in Beam Scanning Tubes.—A. Sandor. (*J. Soc. Mot. Pict. Telev. Engrs*, Oct. 1960, Vol. 69, No. 10, pp. 735–738.) The influence of scanning velocities, phosphor characteristics and background lighting on the real and apparent reduction in vertical spot size is discussed with reference to measurements made using a cathetometer.

621.397.331.24 **1324**

Electron Transmission of Mesh Lenses for Scan Magnification in Television Picture Tubes.—P. J. Dolon & W. F. Niklas. (*J. Brit. Instn Radio Engrs*, Dec. 1960, Vol. 20, No. 12, pp. 911–919.) A comprehensive mathematical analysis of the electron transmission of mesh lenses is given. Experimental measurement methods are detailed, and the results obtained are compared with theoretical values.

621.397.334.24 **1325**

Dynamic Spot Formation in Colour Tubes.—A. Sandor. (*J. Soc. Mot. Pict. Telev. Engrs*, Oct. 1960, Vol. 69, No. 10, pp. 738–742.) An investigation of the spot size requirements in various colour-tube systems and a critical assessment of the Lawrence system in its original form and with different scan-to-grid relations.

621.397.61 **1326**

The Spectral Composition of the Statistical Fluctuations in Present-Day Television Camera Installations.— H. Fix & A. Kaufmann. (*Rundfunktech. Mitt.*, April 1960, Vol. 4. No. 2, pp. 60–65.) The spectral composition of statistical fluctuations is measured on different types of camera tube with or without aperture correction. From this an assessment of the effective signal/noise ratio is made. See also 2897 of 1956 (Theile & Fix).

621.397.61 **1327**

Preamplifiers for Vidicon Cameras using Drift Transistors.—H. Anders. (*Rundfunktech. Mitt.*, April 1960, Vol. 4, No. 2, pp. 66–73.) An experimental amplifier circuit is given and the choice of input circuit and selection of working point for optimum signal/noise ratio are discussed. Noise measurements were made on a number of transistors of different type and make. The spectral distribution of statistical fluctuations is compared with that of a valve amplifier and the visual-interference effects are evaluated. Temperature dependence of operating characteristics and means of minimizing it are also considered.

621.397.61 : 621.396.677 **1328**

The Use of a High-Gain Television Transmitting Aerial in a Populous Area.—Monteath, Millard & Whythe. (See 1074.)

621.397.62 **1329**

Methods for Perfect Black Reproduction in Television.—H. Grosskopf. (*Radio Mentor*, Jan. 1960, Vol. 26, No. 1, pp. 041–043.) Means of achieving close agreement between the black level of the receiver and that of the transmission monitor are discussed. A simple test signal is suggested as a basis for a subjective assessment and for the adjustment of the black level of the receiver. See also 1377 of 1959.

621.397.74 **1330**

Recent Methods and Results of Television Network Planning.—H. Eden, H. W. Fastert & K. H. Kaltbeitzer. (*Rundfunktech. Mitt.*, April 1960, Vol. 4, No. 2, pp. 41–47.) A method of determining dealized networks with minimum mutual nterference between transmitters is proposed which includes the process of 'density adaptation' to suit local differences in transmitter distribution. The application of the method to the preparation of frequency-allocation plans is discussed. For English version see *E.B.U. Rev.*, April 1960, No. 60A, pp. 54–59. See also 717 of February (Correction, *ibid.*, insert).

621.397.74 **1331**

Transmitter Networks with Non-linear Channel Distribution.—F. Maarleveld. (*Rundfunktech. Mitt.*, April 1960, Vol. 4, No. 2, pp. 57–59.) The use of non-linear channel distribution in television network planning is considered; it may provide more favourable results than network planning based on linear distribution (see e.g. 1330 above). For English version see *E.B.U. Rev.*, April 1960, No. 60A, pp. 70–72.

VALVES AND THERMIONICS

621.382.002.2 **1332**

The Diffused Shot-Melting Technique for Making Germanium and Silicon *p-n* Junction Devices.—I. A. Lesk. (*J. electrochem. Soc.*, June 1960, Vol. 107, No. 6, pp. 534–536.) Description of a simple flexible method for making semiconductor devices. Lifetime and resistivity changes which occur during the shot-melting cycle may be minimized by alloy gettering or annealing.

621.382.049.7 : 537.311.33 **1333**

Laminar Junction Layers—New Concept in Microcircuits.—J. E. Allegretti & D. J. Shombert. (*Electronics*, 2nd Dec. 1960, Vol. 33, No. 49, pp. 55–57.) Vapour-phase deposition of single-crystal Si layers is used to form individual semiconductor devices at predetermined locations within the crystal.

621.382.2 : 621.372.632 **1334**

Investigations on Semiconductor Mixer Diodes at 3 000 Mc/s.—G. Salzmann. (*Nachr Tech.*, March 1960, Vol. 10, No. 3, pp. 109–115.) Report on comparative measurements of noise figures and operating characteristics of crystal-diode mixers of East-German and Soviet manufacture, intended for use in waveguide and microstrip circuits.

621.382.23 **1335**

Shift of Peak Voltage with Temperature in Tunnel Diodes.—R. P. Nanavati. (*Proc. Inst. Radio Engrs*, Jan. 1961, Vol. 49, No. 1, p. 349.) Reduction to liquid-nitrogen temperatures caused the peak voltage to increase by 15 to 70% of the value at room temperature.

621.382.23 **1336**

Capacitance of *p-n* Junctions at Low Temperatures.—B. M. Vul & É. I. Zavaritskaya. (*Zh. eksp. teor. Fiz.*, Jan. 1960, Vol. 38, No. 1, pp. 10–17.) Results of capacitance and *Q*-factor measurements on Ge and Si diodes down to liquid-He temperatures and frequencies up to 1 Mc/s are detailed. All the phenomena observed can be explained using a simple equivalent circuit.

621.382.23 : 621.372.44 **1337**

The Design of Varactor Diodes.—J. Hilibrand & C. F. Stocker. (*RCA Rev.*, Sept. 1960, Vol. 21, No. 3, pp. 457–474.) A figure of merit in terms of sub-harmonic-oscillator circuit parameters is suggested. Optimized parameters are given for the design of diodes for forward- and reverse-bias operation.

621.382.23 : 621.372.632 **1338**

Experimental Tunnel-Diode Mixer.—J. C. Greene & E. W. Sard. (*Proc. Inst. Radio Engrs*, Jan. 1961, Vol. 49, No. 1, pp. 350–351.) The measured noise factor of a mixer was found to be in fair agreement with that given theoretically by Breitzer (2929 of 1960) but was larger than that predicted by Chang et al. (2644 of 1960).

621.382.233 **1339**

Uniform Avalanche Effect in Silicon Three-Layer Diodes.—A. Goetzberger. (*J. appl. Phys.*, Dec. 1960, Vol. 31, No. 12, pp. 2260–2261.) "Interaction of current gain and avalanche multiplication in three-layer diodes is utilized to produce uniform avalanche effect, indicated by uniform light emission over the area of a junction. Proof that the effect is caused by the three-layer action is furnished by removing the emitter layer, which changes the light emission to the usually observed microplasma pattern."

621.382.3 **1340**

The Tecnetron as a Circuit Element.—A. V. J. Martin. (*J. Phys. Radium*, July 1960, Vol. 21, Supplement to No. 7, *Phys. appl.*, pp. 113A–122A.) Equivalent circuits of the tecnetron are derived and a study is made of the dependence of its characteristics on frequency.

621.382.3 **1341**

Introduction to the Theory of the Tecnetron.—A. V. J. Martin. (*J. Phys. Radium*, March 1960, Vol. 21, Supplement to No. 3, *Phys. appl.*, pp. 24A–36A.) The basic theory of the device is developed and certain secondary effects and their bearing on practical design are discussed.

621.382.3: 621.317.7 **1342**

Transistor Measurements.—B. N. Harden & R. W. Smith. (*Electronic Technol.*, Feb. 1961, Vol. 38, No. 2, pp. 58–62.) "Equipment for the direct measurement, at frequencies from 0·5 to 100 Mc/s, of the power gain and noise factor of transistors operating as small-signal common-emitter amplifiers is described. The results of a few typical measurements are included, made under defined conditions of external feedback."

621.382.3: 621.385.3 **1343**

A Proof of the Complete Analogy between Transistor and Valve Triode.—H. Tigler. (*Elektronik*, March 1960, Vol. 9, No. 3, pp. 79–81.) Operating characteristics for different circuit configurations are compared.

621.382.3.001.4 **1344**

The Execution and Discussion of Comparative Life Measurements on European Low-Frequency Types of Transistor of Various Makes.—J. S. Vogel & M. J. O. Strutt. (*Arch. elekt. Übertragung*, March 1960, Vol. 14, No. 3, pp. 121–131.) Measurements were made on six equivalent types of Ge transistor. The spread between the data is discussed, and particular reference is made to the 'creep' of measured values and the '48-hour effect'.

621.382.3.012.8 **1345**

Examination of the Usefulness of Zawels' Practical Equivalent Circuit.—O. Müller. (*Elektronische Rundschau*, March 1960, Vol. 14, No. 3, pp. 90–94.) Formulae are given for the h and y parameters of Zawels' circuit [see e.g. 364 of January (Benz)]. Good agreement is found between calculated and measured parameters up to frequencies beyond α cut-off.

621.382.333 **1346**

Potential Distribution and Capacitance of a Graded *p-n* Junction.—S. P. Morgan & F. M. Smits. (*Bell Syst. tech. J.*, Nov. 1960, Vol. 39, No. 6, pp. 1573–1602.) Formulae, graphs, and tables are given which simplify the solution of the equation for the potential distribution. The expression for the capacitance is split into two parts, one of which dominates in the neutral case and the other in the space-charge case.

621.382.333 **1347**

Observation of an Anomaly in Transistor Characteristics.—O. Nakahara. (*J. phys. Soc. Japan*, Aug. 1960, Vol. 15, No. 8, pp. 1537–1538.) An interpretation is given of the origin of the negative collector conductance observed in an alloy *p-n-p* transistor with base of 40-Ω.cm *n*-type Ge. See 3538 of 1958 (Shields).

621.382.333: 621.318.57 **1348**

Switching Times for Alloy Junction Transistors.—P. James & A. F. Newell. (*Mullard tech. Commun.*, June 1960, Vol. 5, No. 44, pp. 159–171.) The equivalent circuit for large-signal operation of a transistor is derived and used to calculate the transient response of transistors in some typical circuits. Methods of measuring the equivalent-circuit parameters are described.

621.382.333: 621.387.4 **1349**

On the Use of 2N504 Transistors in the Avalanche Mode for Nuclear Instrumentation.—R. Fullwood. (*Rev. sci. Instrum.*, Nov. 1960, Vol. 31, No. 11, pp. 1186–1189.) Circuits are described using the transistors as fast discriminators on photomultiplier tubes in nuclear counters, and as pulse generating elements in rectangular-pulse and double-pulse generators.

621.382.333.4 **1350**

The Binistor—a New Semiconductor Device.—N. DeWolf. (*Electronic Ind.*, Aug. 1960, Vol. 19, No. 8, pp. 84–87.) General description of a silicon four-layer device suitable for use in switching and storage circuits.

621.383.41 **1351**

Preparation and Properties of PbTe Photoresistors with Controlled Stoichiometric Composition.—K. Gürs. (*Z. Phys.*, 12th April 1960, Vol. 158, No. 5, pp. 533–552.)

621.383.41 **1352**

Influence of Crystal Size on the Spectral Response Limit of Evaporated PbTe and PbSe Photoconductive Cells.—W. D. Lawson, F. A. Smith & A. S. Young. (*J. electrochem. Soc.*, March 1960, Vol. 107, No. 3, pp. 206–210.) By controlling crystallite size, the response or the absorption of a layer can be made to terminate at any wavelength up to the limit fixed by the energy gap of the compound.

621.383.5 **1353**

Silicon Photovoltaic Cells for Instrumentation and Control Applications.—V. Magee & A. A. Shepherd. (*J. Brit. Instn Radio Engrs*, Nov. 1960, Vol. 20, No. 11, pp. 803–819. Discussion.) The operation of *p-n* junction photocells for detection of visible and near-infrared radiation is described. An account of the detection mechanism is given and construction techniques are outlined. Applications described include relay systems, data reading, machine-tool control and binary counting.

621.383.53 **1354**

Thermal and Optical Behaviour of Phototransistors.—D. Shaw & B. Crump. (*Electronic Engng*, Dec. 1960, Vol. 32, No. 394, pp. 753–757.) Investigation of thermal effects on Ge and Si phototransistors and their application to a precise position-measuring device. Suitable circuits are given for operation of the Ge device at temperatures to 55 °C and Si to about 100 °C.

621.385.032.212 **1355**

Electron Emission from Cold Magnesium Oxide.—H. N. Daglish. (*Proc. Instn elect. Engrs*, Part B, Jan. 1961, Vol. 108, No. 37, pp. 103–110.) Methods of making and processing cathodes of this type are described, and it is shown that stable emission is obtained only from cathodes in a fully oxidized state. The behaviour of these cathodes under various experimental conditions has been examined with particular reference to voltage and temperature effects.

621.385.032.213 **1356**

Space-Charge Neutralization and Thermionic Emission.—R. N. Franklin. (*J. Electronics Control*, Nov. 1960, Vol. 9, No. 5, pp. 385–390.) An exact solution for the density distribution of space charge and the field is derived. The general shape of the potential distribution can be found as a function of the ratio of positive ions to electrons, and it is shown that the transition from pure electron emission to ion emission is smooth and no oscillatory solution for the potential exists.

621.385.032.213 **1357**

Investigation of Electrostatic Emission of Electrons from a Tungsten Emitter in Pulse Operation.—I. I. Gofman, O. D. Protopopov & G. N. Shuppe. (*Fiz. Tverdogo Tela*, June 1960, Vol. 2, No. 6, pp. 1323–1327.) Measurements have been made of I/V characteristics and results are compared qualitatively with theory.

621.385.032.213.13 **1358**

Temperature Variations of an Oxide Cathode produced by the Flow of Thermionic Current.—G. Mesnard & R. Uzan. (*Le Vide*, July/Aug. 1960, Vol. 15, No. 88, pp. 301–312. In French and English.) Results show that temperature variations are different for the core and the external coating of the cathode and that further temperature changes occur during the life of the valve. The mechanism of electron transfer through the coating is found to be strongly influenced by porosity and residual gases.

621.385.032.213.13 **1359**

Emission from Miniature Hollow Cathodes.—A. Sandor. (*Proc. Instn elect. Engrs*, Part B, Jan. 1961, Vol. 108, No. 37, pp. 90–96.) A detailed study of the properties of cathodes internally coated with conventional oxides, with special reference to the need for higher current densities and a smaller optical source.

621.385.032.213.13 **1360**

Pressed-Oxide Nickel-Matrix Cathode below Apertured Electrodes.—A. Sandor. (*Proc. Instn elect. Engrs*, Part B, Jan. 1961, Vol. 108, No. 37, pp. 97–102.) The advantages and construction of this type of high-temperature cathode are outlined, and performance is discussed in detail. Excessive vapour generation limits its usefulness when narrow electrode apertures are used.

621.385.032.213.13 **1361**

Some Electrical and Surface Properties of Sintered Nickel Matrix

Cathodes.—R. W. Fane. (*Brit. J. appl. Phys.*, Nov. 1960, Vol. 11, No. 11, pp. 513–516.) Measurements of the work function of Ni cathodes indicate values in the region of 1 eV. Schottky plots are found to agree with theory provided the cathode surface is polished. For preparation and metallurgy of Ni cathodes see 2600 of 1958 and 4250 of 1959 (Boone et al.).

621.385.032.269.1 **1362**

Determination of Electrode Shapes for Axially Symmetric Electron Guns.—K. J. Harker. (*J. appl. Phys.*, Dec. 1960, Vol. 31, No. 12, pp. 2165–2170.) An analytic continuation of Laplace's equation into a fictitious complex domain makes it suitable for application to a space-charge-limited curvilinear-flow electron gun. The method should be useful in applications where the alternative solution is to use analogues such as the electrolyte tank.

621.385.1: 621.375.2 **1363**

Special Amplifier Valves and their Characteristics: Survey of Types and Examples of Circuits.—W. Geist. (*Elektronische Rundschau*, April 1960, Vol. 14, No. 4, pp. 129–132 . . 136.) Data tables covering valves designed for special applications are given.

621.385.6 **1364**

Kinematic Electron Bunching by Sinusoidal Travelling and Standing Waves in Short Extended Interaction Regions.—H. Golde. (*J. Electronics Control*, Oct. 1960, Vol. 9, No. 4, pp. 285–302.) The treatment follows the general theory developed by Wessel-Berg and is applied to the large-signal condition. The results agree well with those obtained by numerical integration using a computer.

621.385.6: 537.533 **1365**

In What Sense do Slow Waves Carry Negative Energy?—P. A. Sturrock. (*J. appl. Phys.*, Nov. 1960, Vol. 31, No. 11, pp. 2052–2056.) The positive and negative energy respectively of fast and slow space-charge waves, as found in electron tubes and proved by the 'small-amplitude power theorem', is derived in a general way starting with a quadratic Lagrangian function.

621.385.6: 537.533 **1366**

Conservation Laws of an Interacting Electron Beam.—M. C. Pease. (*J. appl. Phys.*, Nov. 1960, Vol. 31, No. 11, pp. 2028–2036.) The linearized theory of electron beams interacting with a circuit is studied. Methods are obtained for determining, from the differential equations of the system, the quadratic invariance, if it exists, which is independent of a given parameter. This leads to a modal description and a kinetic power law, such as that of Chu.

621.385.6: 537.533 **1367**

Oscillations in Long Electron Beams.—B. Agdur. (*Ericsson Tech.*, 1960, Vol. 16, No. 1, pp. 43–57.) Two types of instability in long electron beams confined by magnetic fields are investigated. One, which is dependent on the presence of positive ions trapped in the beam, occurs at frequencies near the plasma frequency of the ions and gives rise to a rotational motion of the electron beam. The other, which is dependent on the presence of slow electrons in the beam, occurs at frequencies close to the gyro-frequency of the electrons.

621.385.6: 537.533: 621.391.822 **1368**

Noise Propagation in Drifting Multi-velocity Electron Beams.—J. A. Morrison. (*J. appl. Phys.*, Nov. 1960, Vol. 31, No. 11, pp. 2066–2067.) Some of the macroscopic formulae of Berghammer & Bloom (2565 of 1960) do not agree with the microscopic numerical calculations based on the distribution-function method of Siegman et al. (749 of 1958).

621.385.6: 621.375.9: 621.372.44 **1369**

Transverse Electron-Beam Waves in Varying Magnetic Fields.—E. I. Gordon. (*Bell Syst. tech. J.*, Nov. 1960, Vol. 39, No. 6, pp. 1603–1616.) The cyclotron wave associated with the rotational motion of the beam electrons and the synchronous wave associated with the spatial configuration of the beam are shown to be coupled by varying magnetic fields.

621.385.6: 621.375.9: 621.372.44 **1370**

An Electron-Beam Parametric Amplifier for the 200-Mc/s Region.—G. O. Chalk. (*Proc. Instn elect. Engrs*, Part B, Jan. 1961, Vol. 108, No. 37, pp. 125–132.) The operation of the Adler tube [see e.g. 361 of 1960 (Adler et al.)] is outlined. The construction of a valve giving a noise figure of 1·6 dB, 10 dB gain and bandwidth 25 Mc/s is given.

621.385.63 **1371**

Experimental Travelling-Wave Tubes.—G. M. Clarke. (*Electronic Technol.*, Feb. 1961, Vol. 38, No. 2, pp. 38–45.) The design and performance of valves with c.w. outputs up to 300 W and gains greater than 20 dB are described.

621.385.63 **1372**

The Magnetic Field and Flux Distributions in a Periodic Focusing Stack for Travelling-Wave Tubes.—M. J. Schindler. (*RCA Rev.*, Sept. 1960, Vol. 21, No. 3, pp. 414–436.) The problem is treated as a static one, rather than by the usual electrodynamic analogy, taking account of the charges on the disk and outer hub surfaces, and the effect of neighbouring magnets. Measurements verify the validity of the approach, and design formulae are given.

621.385.632.14 **1373**

A Corrugated Bent Waveguide as a Delay System with Positive Dispersion.—Z. I. Taranenko. (*Izv. vyssh. uch. Zav., Radiotekhnika*, Jan./Feb. 1960, Vol. 3, No. 1, pp. 30–39.) An examination of the dispersion curves for an electron beam in a slow-wave structure comprising a rectangular waveguide: (*a*) with equal transit apertures, and (*b*) with apertures of two different diameters arranged alternately. Formulae are derived for the effective impedance of the system.

621.385.633 **1374**

Operation of the Backward-Wave Oscillator.—M. Y. Wong, G. D. Sims & I. M. Stephenson. (*Nature, Lond.*, 3rd Dec. 1960, Vol. 188, No. 4753, pp. 803–804.) The travelling-wave-tube analogue described earlier [1078 of 1960 (Sims & Stephenson)] has been operated as a backward-wave oscillator and measurements have been made of the voltage distribution along the slow-wave circuit. These indicate that a 3-mode theory at least is necessary to explain the operation of backward-wave oscillators.

621.385.64 **1375**

General Steady-State Theory of Cylindrical Magnetrons.—P. A. Lindsay. (*J. Electronics Control*, Oct. 1960, Vol. 9, No. 4, pp. 241–283.) The theory takes into account space charge and the Maxwellian distribution of emitted electrons, but collision effects are neglected. Calculations are given of the volume density of the electrons and the radial and azimuthal components of the current density at any point between cathode and anode.

621.385.644 **1376**

An Experimental Wide-Tuning-Range Inverted Magnetron.—A. Singh & N. C. Vaidya. (*Proc. Inst. Radio Engrs*, Dec. 1960, Vol. 48, No. 12, pp. 2035–2036.) Constructional details and performance data are given for an inverted interdigital magnetron tuned by a coaxial line. See 4066 of 1957 (Singh).

621.385.644 **1377**

The Resonator and Output Couplers for a Wide-Tuning-Range Inverted Magnetron.—A. Singh, N. C. Vaidya, R. A. Rao, K. Chandra & G. S. Siddhu. (*J. Instn Telecommun. Engrs, India*, June 1960, Vol. 6, No. 4, pp. 153–160.) Measurements were made on an inverted interdigital magnetron. With an iris coupling the resonator to the output line, uniform external Q was obtained over a 2:1 band. See also 1376 above.

621.385.832.032.265: 621.317.755 **1378**

Velocity Modulation and Related High-Frequency Deflection Errors of the Travelling-Wave Deflection System.—J. Goldberg. (*Rev. sci. Instrum.*, Dec. 1960, Vol. 31, No. 12, pp. 1320–1325.) A mathematical analysis is given of the potential and electric-field distributions. Generalized expressions are derived for the errors in beam deflection due to nonuniformity and dispersion.

621.385.832.032.269: 621.317.329 **1379**

Method for Theoretical Investigation of Type-O Focusing.—J. E. Picquendar & O. Cahen. (*Rev. tech. Comp. franç. Thomson-Houston*, Feb. 1960, No. 32, pp. 7–39.) Curves, tables and simplified equations are given for calculating electron-gun perveance and tracing electron-beam trajectories under the influence of an axial magnetic field.

621.387: 621.362 **1380**

Potential Distributions in a Low-Pressure Thermionic Converter.—Auer. (See 1279.)

621.387: 621.362 **1381**

Experimental Investigations of the Cesium Plasma Cell.—Ranken, Grover & Salmi. (See 1280.)

Abstracts and References

COMPILED BY THE RADIO RESEARCH ORGANIZATION OF THE DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH AND PUBLISHED BY ARRANGEMENT WITH THAT DEPARTMENT

The abstracts are classified in accordance with the Universal Decimal Classification. They are arranged within broad subject sections in the order of the U.D.C. numbers, except that notices of book reviews are placed at the ends of the sections. U.D.C. numbers marked with a dagger (†) must be regarded as provisional. The abbreviations of journal titles conform generally with the style of the World List of Scientific Periodicals. An Author and Subject Index to the abstracts is published annually; it includes a list of journals abstracted, the abbreviations of their titles and their publishers' addresses. Copies of articles in journals referred to are not available from Electronic Technology. *Application must be made to the individual publishers concerned.*

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ACOUSTICS AND AUDIO FREQUENCIES

534.2-14 **1382**

Transient Sound Propagation in a Layered Liquid Medium.—J. W. C. Sherwood. (*J. acoust. Soc. Amer.*, Dec. 1960, Vol. 32, No. 12, pp. 1673–1684.) A theoretical analysis of transient sound propagation between source and receiver located at arbitrary points in a horizontally stratified liquid.

534.21 **1383**

Propagation of Sonic and Ultrasonic Waves in Natural Waveguides.—L. Brekhovskikh. (*Usp. fiz. Nauk*, Feb. 1960, Vol. 70, No. 2, pp. 351–360.) Discussion of sound propagation to very great distances in the sea and in the atmosphere by a natural waveguide action.

534.24-14: 534.88 **1384**

Fluctuations of Sound Reflected from the Sea Surface.—C. S. Clay. (*J. acoust. Soc. Amer.*, Dec. 1960, Vol. 32, No. 12, pp. 1547–1551.) Data obtained from an experiment in which both source and receiver are at a depth of about 3 000 ft (1385 below) are compared with calculations based on the theory of Eckart (2541 of 1953).

534.24-14: 534.88 **1385**

Fluctuations in Surface-Reflected Pulsed C.W. Arrivals.—M. V. Brown & J. Ricard. (*J. acoust. Soc. Amer.*, Dec. 1960, Vol. 32, No. 12, pp. 1551–1554.) A 168-c/s signal was transmitted at a depth of 2 880 ft and both direct and surface-reflected components of the signal received at a depth of 3 000 ft were analysed for fluctuations as a function of range and angle of incidence. A $(\cos\phi)^{5.5}$ relation was found between the relative standard deviation of the energy and the incident angle, as measured from the normal.

534.286.2 **1386**

The Influence of Edges on the Sound Absorption of Porous Materials.—W. Kuhl. (*Akust. Beihefte*, 1960, No. 1, pp. 264–276.) Measurements of sound absorption were made on various arrangements of absorber plates in a reverberation chamber. The results are discussed with reference to the work of other authors to assess the magnitude of the edge effect under different conditions.

534.512.2: 538.566: 535.31 **1387**

Electromagnetic Reflection from Sound Waves.—H. J. Schmitt & T. T. Wu. (*J. acoust. Soc. Amer.*, Dec. 1960, Vol. 32, No. 12, pp. 1660–1667.) The reflection of e.m. waves normally incident on the wavefronts of a semi-infinite standing sound wave in a liquid is discussed theoretically.

534.6: 534.322.3 **1388**

Development of a Noise Generator for Producing Noise of Constant Spectral Bandwidth with any Desired Centre Frequency and Constant-Amplitude Time Functions.—H. Niese. (*Nachr-Tech.*, May 1960, Vol. 10, No. 5, pp. 196–204.) The noise generator described provides bands of f.m. noise of bandwidth 40, 100, 200 and 400 c/s with centre frequency adjustable over the range 20 c/s–17 kc/s. See also 8 of January.

534.7 **1389**

Electro-acoustics for Human Listeners.—C. Cherry. (*J. Brit. Instn Radio Engrs*, Jan. 1961, Vol. 21, No. 1, pp. 5–15. Discussion.) A review of existing knowledge of electro-acoustics in relation to the listener. The present theories of stereophonic hearing are shown to be incomplete and a plea is made for further study.

534.78 **1390**

Speech Processing by the Selective Amplitude System.—L. R. Spogen, H. N. Shaver, D. E. Baker & B. V. Blom. (*J. acoust. Soc. Amer.*, Dec. 1960, Vol. 32, No. 12, pp. 1621–1625.) A system is described in which sampling times are determined from the speech waveform; the average rate is considerably less than that required for periodic sampling.

534.79 **1391**

A Method for the Calculation of Loudness.—E. Zwicker. (*Akust. Beihefte*, 1960, No. 1, pp. 304–308.) A simplified graphical method is described for evaluating loudness levels from third-interval level diagrams. See 3349 of 1960.

534.79 **1392**

The Difference between the Curves of Equal Loudness for a Plane Wave and a Diffuse Sound Field.—G. Jahn. (*Hochfrequenztech. u. Elektroakust.*, April 1960, Vol. 69, No. 2, pp. 75–81.) Objective measurements were made to determine the influence of the shape of the sound field on loudness sensation; these measurements are based on the results given in 740 of 1960. A comparison is made with the loudness curves obtained by subjective tests (1844 of 1960) and relatively good agreement is found.

534.844.1 + [621.317.2 : 538.566.08 **1393**

A New Reverberation Chamber for Sound and Electromagnetic Waves.—E. Meyer, G. Kurtze, H. Kuttruff & K. Tamm. (*Akust. Beihefte*, 1960, No. 1, pp. 253–264.) The acoustic reverberation time of the room described is 33 s at 100 c/s and 13 s at 1 kc/s; the sound insulation results in about 80 dB attenuation. The chamber is internally lined with copper foil and the e.m. wave reverberation time is 400 μs at 10 Gc/s without scattering objects; this corresponds to a Q-factor of $1{\cdot}7 \times 10^8$.

534.845 **1394**

Design of Acoustic Resonator Panels.—C. R. Nagaraja Rao. (*J. sci. industr. Res.*, Oct. 1960, Vol. 19A, No. 10, pp. 506–509.) A design procedure based on the Helmholtz formula has been verified experimentally for sound waves normally incident on the panel.

534.845.1 **1395**

Determination of Sound Absorption Coefficients using a Pulse Technique.—C. L. Rogers & R. B. Watson. (*J. acoust. Soc. Amer.*, Dec. 1960, Vol. 32, No. 12, pp. 1555–1558.) A laboratory method is described by means of which sound absorption coefficients can be determined as a function of angle of incidence using a loudspeaker at the focus of a paraboloidal sound mirror.

621.395.6 : 621.372.44 **1396**

Exact Solution of a Time-Varying Capacitance Problem.—Macdonald & Edmondson. (See 1452.)

621.395.61 **1397**

Absolute Determination of the Response of Microphones in a Diffuse Sound Field.—H. G. Dimmel. (*Akust. Beihefte*, 1960, No. 1, pp. 277–280.) Application of the reciprocity method in a diffuse sound field. The calibration of a condenser microphone for the range 500–16 000 c/s in a reverberation chamber is described.

621.395.61 **1398**

Determination of the Pressure Transmission Factor of Microphones.—H. G. Dimmel & H. Mraz. (*Arch. tech. Messn.*, April 1960, No. 291, pp. 65–68.) Review of methods and apparatus used for the pressure calibration of microphones. About 40 references.

621.395.623.8 **1399**

Loudspeaker with Increased Degree of 'Presence'.—H. Harz. (*Elektronische Rundschau*, May 1960, Vol. 14, No. 5, pp. 193–197.) Description of an array of loudspeakers for use in broadcast studios. Facilities are provided for the adjustment of the ratio of direct to diffuse sound in order to achieve a greater degree of realism.

621.395.625.3 **1400**

Investigation of the Phenomena of Synchronism in a Magnetic Tape Recorder with the Aid of Electromechanical Analogues.—W. Wolf. (*Hochfrequenztech. u. Elektroakust.*, April 1960, Vol. 69, No. 2, pp. 41–52.) The equivalent circuit of a mechanical tape transport system is derived. The electrical analogues of the various mechanical parameters are evaluated and their application in improving the design of tape transport mechanisms is discussed.

621.395.625.3 : 538.221 **1401**

Particle Interaction in Magnetic Recording Tapes.—Woodward & Della Torre. (See 1590.)

AERIALS AND TRANSMISSION LINES

621.372.8 : 621.317.39 : 531.71 **1402**

Measurement Method for Determining the Internal Dimensions of Waveguides.—J. Bachel. (*Frequenz*, April 1960, Vol. 14, No. 4, pp. 131–134.) The method described is suitable for long waveguide, of metal or internally metallized at least at the points of measurement; dimensions can be measured to within $\pm 1\,\mu$. The underlying principle is that of a measurement of capacitance between one inner wall and a metal plate accurately positioned on and insulated from the opposite inner wall. The method is also applicable to circular waveguide. Test procedure and results are discussed.

621.372.8.09 **1403**

Transport of Angular Momentum in a Waveguide.—G. Toraldo di Francia. (*Alta Frequenza*, April 1960, Vol. 29, No. 2, pp. 148–155.) In a waveguide where the field consists of two or more superposed degenerate modes the angular momentum travels at the same velocity as the energy. In the case of two nondegenerate modes the momentum has a velocity equal to the arithmetic mean of the group velocities of both modes.

621.372.81 **1404**

The Theory of Waveguides and Cavities: Part I—A General Approach to the Exact Theory of Waveguides and Cavities.—R. A. Waldron. (*Electron. Technol.*, March 1961, Vol. 38, No. 3, pp. 98–105.)

621.372.822 **1405**

The Rotation of Polarization with the Twist in a Rectangular Waveguide.—K. Schwartze. (*Frequenz*, April 1960, Vol. 14, No. 4, pp. 123–126.) The plane of polarization is rotated only through about 1/5 the angle of twist of a rectangular waveguide. In waveguide carrying two waves of differing polarization the coupling from one to the other depends only on the relative twist between input and output cross-sections; for 3° twist the amount is 37 dB.

621.372.823 : 621.372.852.2 **1406**

A Circular-Electric Optical Junction and some Channel-Dropping Filters.—L. A. Marcatili. (*Bell Syst. tech. J.*, Jan. 1961, Vol. 40, No. 1, pp. 185–196.) A description of a telescopically mounted Riblet short-slot coupler adjusted for 3 dB power division at 55 Gc/s with a bandwidth of 20%, a balance of 0·5 dB and isolation better than 23 dB. Application to a circular waveguide communication system in conjunction with mode conversion filters (1417 below) is considered.

621.372.823 : 621.372.852.1 **1407**

Band-Splitting Filter.—E. A. Marcatili & D. L. Bisbee. (*Bell Syst. tech. J.*, Jan. 1961, Vol. 40, No. 1, pp. 197–212.) A splitting transition between two adjacent sub-bands covering one octave at mm λ is brought about within 160 Mc/s by a constant-resistance filter containing an elbow and a hybrid junction operating with 2-in.-diameter waveguide.

621.372.823 : 621.372.852.5 **1408**

Mode Exciters in Circular Waveguides.—K. Noda. (*Rec. elect. Commun. Lab., Japan*, Sept.–Oct. 1960, Vol. 8, Nos. 9–10, pp. 665–676.) Resonant-iris-type exciters have been developed for several kinds of modes. They have the advantage of being small in size and weight but have a restricted bandwidth.

621.372.823 : 621.372.853.1 **1409**

Circular Electric Wave Transmission through Hybrid-Mode Waveguide.—K. Noda. (*Rec. elect. Commun. Lab., Japan*, Sept.–Oct. 1960, Vol. 8, Nos. 9–10, pp. 626–664.) "General formulae for mode generation from distributed sources are derived for hybrid-mode waveguides. Using the formulae, the mode conversion in irregular parts of the dielectric layer in a dielectric-coated waveguide is calculated. Coupling between modes at geometrical imperfections and at intentional bends are described as the relations between the normal hybrid modes. The coupling coefficients between the TE_{01} and HY_{-01} modes in the curved helix waveguide are obtained as functions of the arbitrary wall impedance. Several other transmission characteristics in the hybrid-mode waveguide are also analyzed."

621.372.823.2 **1410**

The Transmission Characteristics of H_{01} Waveguide with Statistically Distributed Irregularities.—H. Lewin. (*Frequenz*, April 1960, Vol. 14, No. 4, pp. 135–142.) The influence of random distribution of axial curvature and cross-sectional deformation in circular waveguide on propagation of desired and unwanted modes is investigated using autocorrelation functions. Examples are given of the calculation of directional tolerances using the Gaussian distribution as a basis for the autocorrelation function.

621.372.829 **1411**

Nonsymmetrical Helix Waveguide.—H. G. Unger. (*Bell Syst. tech. J.*, Jan. 1961, Vol. 40, No. 1, pp. 235–258.) Two cases are analyzed: (a) random imperfections in the cross-section defined in terms of eccentricity, tilt, and ellipticity; (b) uniform imperfections. Random imperfections lead to mode conversion and the resulting loss is similar to that obtained without the helix, but uniform imperfections give considerably greater loss with the helix than without.

621.372.829 **1412**

Normal Modes and Mode Conversion in Helix Waveguide.—H. G. Unger. (*Bell*

Syst. tech. J., Jan. 1961, Vol. 40, No. 1, pp. 255–280.) An analysis of unwanted modes and their coupling coefficients due to guide curvature and deformation leads to consideration of mode-absorbing filters consisting of lengths of circular helical guide, and the effects of random curvature and random ellipticity.

621.372.831.4 **1413**

The 3-dB Coupler.—W. Stöwer. (*Frequenz*, April 1960, Vol. 14, No. 4, pp. 117–121.) The operation of a short-slot hybrid junction is explained and its characteristics are derived. A method of reducing the physical length of such couplers is outlined and design features of a 3-dB coupler are discussed.

621.372.831.6 **1414**

The Design of Two-Step Transforming Sections for Waveguide.—W. Hahers. (*Frequenz*, April 1960, Vol. 14, No. 4, pp. 126–131.) A method is given for the design calculation of two-step sections coupling rectangular waveguides of different height but equal width with minimum reflection in a given frequency band. A two-stage transformer for the range 3·0–4·2 Gc/s was designed by this method and by means of certain mechanical corrections a section was obtained whose measured reflection coefficient agrees closely with the theoretical optimum.

621.372.852.323 **1415**

Experimental Investigations of Passive Broadband Isolators.—E. Steinhart. (*Nachrichtentech. Z.*, April 1960, Vol. 13, No. 4, pp. 183–191.) Measurements of directional attenuation and phase shift have been made with reference to the theory given earlier (815 of February), and the influence of ferrite dimensions on isolator characteristics has been investigated systematically. A method of self-compensation of temperature effects is described which is adequate up to 70 °C.

621.372.852.4 **1416**

A Polarization Filter with Symmetrically Excitation of H_{11} Waves.—E. Schiergraf. (*Frequenz*, April 1960, Vol. 14, No. 4, pp. 123–125.) In the polarizer described the two H_{11} modes are symmetrically excited in a circular waveguide; this method does not give rise to undesirable modes such as E_{01} and extends the usable range of frequencies.

621.372.852.3 **1417**

Waveguide-transmission Filters.—H. G. Unger. (*Bell Syst. tech. J.*, Jan. 1961, Vol. 40, No. 1, pp. 169–196.) Describes theory and construction of low-loss filters that simultaneously drop channels and equalize from circular to rectangular waveguide modes. The advantages over other methods for the (one-) range are discussed.

621.396.67 **1418**

Wide-Band Omnidirectional Systems of Cylindrical Symmetry with High-Pass Shielding.—H. Wilhelm. (*Nachrichtentech. Z.*, April 1960, Vol. 13, No. 4, pp. 161–168.) Measurements of input impedance and reflection coefficient were made in the frequency range 200–4 000 Mc/s on omnidirectional radiators of differing shape. The input impedance was calculated for lower frequencies and the lower cut-off frequency is determined. The optimum shape of a wide-band radiator is a cone with smoothly rounded edges using a reflection-free feed arrangement (see 2569 of 1960).

621.396.676: 621.317.332: 621.398 **1419**

Measuring Antenna Impedance in the Ionosphere.—O. C. Haycock & K. D. Baker. (*Electronics*, 13th Jan. 1961, Vol. 34, No. 2, pp. 88–92.) Both resistive and capacitive components are measured continuously from the standing-wave pattern set up on an artificial transmission line terminated by the aerial.

621.396.677: 621.396.62 **1420**

Designing Low-Noise Antennas.—R. Caldecott & W. H. Peake. (*Electronics*, 20th Jan. 1961, Vol. 34, No. 3, pp. 60–63.) With the advent of very-low-noise receivers, the noise emphasis must be shifted to the receiving aerial. The effects of mismatch, attenuation, sidelobes and spill-over are considered. The optimum aerial is not necessarily the one with maximum gain.

621.396.677.32 **1421**

Endfire Antennas.—G. Broussaud & E. Spitz. (*Proc. Inst. Radio Engrs*, Feb. 1961, Vol. 49, No. 2, pp. 345–346.) The aerial, consisting of a two-wire line surrounded by a helix, has a gain of 10–20 dB between 2 and 4 Gc/s with secondary lobes below 20 dB. See also 2236 of 1960 (Wickersham).

621.396.679.4 **1422**

Feeders for Electronic-Wave Aerials of High-Power Racing.—H. Lauth & W. Stolte. (*Frequenz*, April 1960, Vol. 14, No. 4, pp. 142–155.) The transmission characteristics of long feeders consisting of flexible or rigid coaxial lines, waveguides, or surface-wave transmission line are discussed. The results are given of theoretical and experimental investigations of attenuation and reflection coefficient on long runs of rectangular waveguide constructed from concentric identical elements. Waveguide components for use in aerial feeders are described. Results are also included of measurements on feeders of the Goubau-line type. 36 references.

AUTOMATIC COMPUTERS

681.142 **1423**

A Multipurpose Computer Element.—C. B. Taylor. (*Electron. Engng*, Feb. 1961, Vol. 33, No. 386, pp. 96–98.) A "magnetic-pulse" waveform reshaper is described which in conjunction with a number of logical gates can be used as a basic element in computer design.

681.142: 621.382.323 **1424**

Microcircuit Binary Full Adder uses Unipolar Transistors.—M. E. Sadicky, J. T. Wallmark & S. M. Marcus. (*Electronics*, 23rd Dec. 1960, Vol. 33, No. 52, pp. 46–49.) Unipolar transistors are used for both active and passive elements.

CIRCUITS AND CIRCUIT ELEMENTS

621.3.049.7 **1425**

Circuit Considerations relating to Micro-electronics.—J. J. Suran. (*Proc. Inst. Radio Engrs*, Feb. 1961, Vol. 49, No. 2, pp. 420–426.) A discussion of the problems associated with microminiaturization, especially power dissipation and its relation to circuit functions and packing density.

621.314.2: 621.391.822 **1426**

Backbarrier Noise in Transformer Cores.—K. G. Warren. (*Electronic Technol.*, March 1961, Vol. 38, No. 3, pp. 89–94.) The following are discussed: (*a*) isolation and measurement of the noise, (*b*) its relation to the slope of the hysteresis loop and the cycling rate, (*c*) an equivalent circuit which includes the noise source, and (*d*) the frequency spectrum of the noise when sinusoidally polarized.

621.318.57: 621.382.23 **1427**

Margin Considerations for an Esaki-Diode Resistor OR Gate.—H. K. Gummel & F. M. Smits. (*Bell Syst. tech. J.*, Jan. 1961, Vol. 40, No. 1, pp. 233–252.) Worst-case margin considerations imply that applications are restricted to storage systems, flip-flops, shift registers and the like.

621.319.45 **1428**

A Helix-Type Variable Capacitor.—Y. Yamamoto. (*Proc. Inst. Radio Engrs*, Feb. 1961, Vol. 49, No. 2, pp. 422–423.) Maximum-to-minimum capacitance ratios of 10 000 or more are obtainable.

621.372.41 **1429**

Two-Terminal Network Functions through Prescribed Points. Additions to the Interpolation Problem of Pick and Nevanlinna.—H. Frank. (*Nachrichtentech. Z.*, May 1960, Vol. 13, No. 5, pp. 240–245.) The synthesis of two-terminal networks consisting of resistive, inductive and capacitive elements and having a given impedance function is considered.

621.372.412: 621.372.54 **1430**

Quartz 45° Type Filter Crystals for the Frequency Range 0·7 to 40 Mc/s.—R. Bechmann. (*Proc. Inst. Radio Engrs*, Feb. 1961, Vol. 49, No. 2, pp. 523–524.) Design data are given for suppressing the unwanted modes to at least 40 dB below the main mode. See also 1499 of 1960.

621.372.413 **1431**

Design of Cavity Resonators with Maximum Q Factor.—W. Otto. (*Nachrichtentech.*, Mar., June & Aug. 1960, Vol. 10, Nos. 3, 6 & 8, pp. 109–116, 269–272 & 361–372.) Summary of theory and design formulae for cylindrical cavity resonators with details of conventional features and coupling arrangements.

621.372.46: 621.395.6 **1432**

Exact Solution of a Time-Varying Capacitance Problem.—J. R. Macdonald & D. E. Edmondson. (*Proc. Inst. Radio Engrs*, Feb. 1961, Vol. 49, No. 2, pp. 453–

466.) A new method is developed giving a closed-form solution for the harmonics generated by a sinusoidally varying capacitance in series with a fixed resistor and battery. Practical applications are discussed, with reference to the condenser microphone, the vibrating-reed electrometer and a special loudspeaker improvement.

621.372.5 **1433**

The Quadratic Invariances of a Generalized Network.—M. C. Pease. (*Proc. Inst. Radio Engrs*, Feb. 1961, Vol. 49, No. 2, pp. 488–497.) In systems where the matrix operator has eigenvalues which are unity or can be taken in reciprocal conjugate pairs, the number of invariant quadratic forms is at least equal to the number of degrees of freedom.

621.372.54 **1434**

The Imaginary Part of the Characteristic Impedance in the Pass Band of Filter Circuits.—W. Herzog. (*Nachrichtentech. Z.*, April 1960, Vol. 13, No. 4, pp. 179–182.) The use of filter circuits with complex characteristic impedance in the pass band extends the number of possible bridge-type filters. Filters with variable pass band can be realized.

621.372.54 **1435**

A Quick Method for the Design of Butterworth Filters.—J. S. Bell & P. G. Wright. (*Electronic Engng*, Feb. 1961, Vol. 33, No. 396, pp. 106–108.) A design procedure and worked example are given.

621.372.543.2 **1436**

A Variable-Bandwidth Band-Pass Filter.—J. Holland. (*Electronic Engng*, Feb. 1961, Vol. 33, No. 396, pp. 100–105.) "A method is described whereby several bandwidths may be obtained in an *LC* filter employing one set of inductors only. The design of a typical filter with an actual plot of its attenuation characteristic is included."

621.372.543.2 **1437**

A Continuously Variable Band-Pass Filter for the Audio-Frequency Range.—W. Ohme. (*Frequenz*, May 1960, Vol. 14, No. 5, pp. 182–186.) The design of a band-pass filter whose bandwidth and lower cut-off frequency are continuously variable is described. The requisite crystal filters are derived from the band-pass elements given by image-parameter theory. The equipment and some of its response curves are illustrated.

621.372.63 **1438**

Synthesis of *N*-Port Active *RC* Networks.—I. W. Sandberg. (*Bell Syst. tech. J.*, Jan. 1961, Vol. 40, No. 1, pp. 329–347.) It is proved that N is the sufficient and, in general, minimum number of controlled sources required to realize an arbitrary $N \times N$ matrix of real rational functions as a transformerless active *RC* N-port network.

621.373.421.1: 539.2: 538.569.4 **1439**

The Hamiltonian Formalism of Damping in a Tuned Circuit.—K. W. H. Stevens. (*Proc. phys. Soc.*, 1st Feb. 1961, Vol. 77, No. 494, pp. 515–525.) An *LC* circuit coupled to a transmission line is studied as an example of introducing damping into the quantum-mechanical treatment of a harmonic oscillator. The problem of coupling a spin system to the current in the inductance is also studied.

621.373.43 **1440**

The Stability of Relaxation Oscillations Synchronized by Pulses.—E. De Castro. (*Alta Frequenza*, April 1960, Vol. 29, No. 2, pp. 206–231.) A finite-difference equation is derived for the pulse synchronization of relaxation oscillators. Solutions are obtained by a graphical method and possibilities of simplification are considered. The procedure is also applied to the case of frequency division. Calculated parameters are verified by measurements on a multivibrator circuit.

621.373.431.1 **1441**

Description of the Change-Over Process in Multivibrators.—G. Kohn. (*Arch. elekt. Übertragung*, May 1960, Vol. 14, No. 5, pp. 193–203.) The dynamic processes occurring in multivibrators are described using a graphical method. A bistable circuit is considered as example, and a system of curves representing all possible internal processes is derived on the basis of differential equations for the characteristic time functions of this circuit. The influence of the duration and amplitude of the triggering pulse on transition time is determined.

621.374: 681.188 **1442**

Decoding Circuits with Semiconductor Elements.—E. Oehme. (*Hochfrequenztech. u. Elektroakust.*, April 1960, Vol. 69, No. 2, pp. 52–61.) Various types of circuit for binary decoding systems are given and requirements regarding the minimum number of semiconductor diodes and transistors to be used are evaluated and compared.

621.374.4: 621.396 **1443**

The Problem of Frequency Synthesis.—H. J. Finden. (*J. Brit. Instn Radio Engrs*, Jan. 1961, Vol. 21, No. 1, pp. 95–103.) Review of the basic techniques employed for addition, subtraction and division in frequency synthesizers.

621.374.5: 534.213-8: 535.215 **1444**

Continuously Variable Glass Delay Line.—H. A. Brouneus & W. H. Jenkins. (*Electronics*, 13th Jan. 1961, Vol. 34, No. 2, pp. 86–87.) Stress waves are optically monitored by using the birefringent properties of glass under stress.

621.375.232.4 **1445**

Designing Grounded-Grid Amplifiers with Controlled Gain.—J. W. Rush. (*Electronics*, 23rd Dec. 1960, Vol. 33, No. 52, pp. 50–53.) A six-stage low-noise i.f. amplifier with microminiature ceramic triodes is described.

621.375.4.018.783 **1446**

Review of Nonlinear Distortion in Transistor Stages, including Cross-Modulation.—H. Lotsch. (*Arch. elekt. Übertragung*, May 1960, Vol. 14, No. 5, pp. 204–216.) The nonlinear transfer function is approximated by a Taylor series expansion, and from this equations are derived for various types of distortion in earthed-emitter transistor circuits. Methods of compensating cross-modulation are considered. The results of cross-modulation measurements are found to be similar to those obtained by Akgün & Strutt (3034 of 1960).

621.375.423 **1447**

Selective *RC* Amplifier using Transistors.—R. Hutchins. (*Electronic Engng*, Feb. 1961, Vol. 33, No. 396, pp. 84–87.) Investigation of the use of phase-shift networks in transistor circuits. The dual of the Wien-bridge arm is used to form an oscillator and a selective amplifier, which has constant gain while the selectivity and tuning are continuously variable.

621.375.432 **1448**

Equation for the Performance of a Nonlinear Transistor Amplifier.—I. Gumowski, J. Lagasse & Y. Sevely. (*C. R. Acad. Sci., Paris*, 14th March 1960, Vol. 250, No. 11, pp. 1995–1997.) A first-order differential equation is derived to describe the performance of a nonlinear amplifier discussed earlier by Gumowski (4150 of 1960).

621.375.9: 538.569.4 **1449**

Investigation of the Shift in Frequency and of the Amplitude of Oscillations of a Maser-Type Self-Oscillator with Liquid Flow.—C. Fric. (*C. R. Acad. Sci., Paris*, 28th March 1960, Vol. 250, No. 13, pp. 2353–2355.) An experimental investigation of the effect of detuning a maser oscillator of the type described earlier (798 of 1960) and of the influence of the rate of flow on the resonance line width. The range of oscillation extends from 1·7 kc/s (0·4 G) to 29·6 Mc/s (7 kG).

621.375.9: 538.569.4 **1450**

Cross-Relaxation Phenomena in Solid-State Masers.—S. A. Ahern, P. A. Gould & J. C. Walling. (*J. Electronics Control*, Dec. 1960, Vol. 9, No. 6, pp. 477–480.) With the direction of the applied magnetic field close to the c-axis of a ruby maser, amplification for different crystal orientations was confined to two narrow frequency bands within the 2·8–3·2 Gc/s range used. Possible mechanisms concerned are spin-spin energy exchanges involving (*a*) four ions, and (*b*) seven ions.

621.375.9: 621.372.44: 537.311.33 **1451**

Three-Terminal Variable-Capacitance Semiconductor Device.—L. J. Giacoletto. (*Proc. Inst. Radio Engrs*, Feb. 1961, Vol. 49, No. 2, pp. 510–511.) An analysis of the operation of the device which is based on the change in junction transition capacitance, associated with the change in collector voltage gradient, in an avalanche-controlled semiconductor amplifier.

621.375.9: 621.372.44: 621.382.23 **1452**

A Varactor-Diode Parametric Standing-Wave Amplifier.—H. Brett, F. A. Brand & W. G. Matthei. (*Proc. Inst. Radio Engrs*, Feb. 1961, Vol. 49, No. 2, pp. 509–510.) Details are given of experimental work on the type of amplifier discussed by Landauer (*ibid.*, July 1960, Vol. 48, No. 7, pp. 1328–1329).

621.376: 621.382.23 **1453**

Using Voltage-Variable Capacitors in Modulator Design.—A. C. Todd, R. P.

Schuck & H. M. Sachs. (*Electronics*, 20th Jan. 1961, Vol. 34, No. 3, pp. 56–59.) Circuits and design equations are given for phase and frequency modulators and for s.s.b. amplitude modulators.

621.376.23: 621.316.8 **1454**

Pseudo-rectification and Detection by Simple Bilateral Nonlinear Resistors.—J. E. Bridges. (*Proc. Inst. Radio Engrs*, Feb. 1961, Vol. 49, No. 2, pp. 469–478.) An analysis of a.c./d.c. converting circuits using symmetrical nonlinear resistors, the operation of which may be largely independent of temperature. Two applications are described: for developing the h.v. focusing potential bias for a picture tube, and for improving the detection threshold of a photoelectric sensing device.

GENERAL PHYSICS

537.313: 530.17 **1455**

Gauss's Principle of Least Constraint applied to Electrical Networks.—A. von Weiss. (*Arch. elekt. Übertragung*, May 1960, Vol. 14, No. 5, pp. 235–236.) Gauss's principle of mechanics, when adapted to electrical networks, leads to Kirchhoff's laws.

537.525 **1456**

Swept Langmuir Probe System for Intense Gas Discharges.—H. W. Jones & P. A. H. Saunders. (*J. sci. Instrum.*, Dec. 1960, Vol. 37, No. 12, pp. 457–459.) Apparatus, including a low-impedance voltage sweep generator, and a logarithmic amplifier, is described, for measurement of electron temperatures up to 2×10^4 °K and ion densities up to 5×10^{14}/cm^3.

537.533: 537.56 **1457**

Exploration of Oscillating Beam-Plasma Fields with a Transverse Electron Beam.—A. Garscadden & K. G. Emeleus. (*J. Electronics Control*, Dec. 1960, Vol. 9, No. 6, pp. 473–476.) The results appear to be compatible with considerable randomization and possible break-up of the main beam by the oscillations.

537.534: 537.311.33 **1458**

Electrodynamics of the Image Force.—F. Ollendorff. (*Arch. Elektrotech.*, 11th April 1960, Vol. 45, No. 3, pp. 169–187.) The processes of ion emission and absorption at semiconductor surfaces are analysed. See 594 of February.

537.56 **1459**

Electron Density Fluctuations in a Plasma.—E. E. Salpeter. (*Phys. Rev.*, 1st Dec. 1960, Vol. 120, No. 5, pp. 1528–1535.) The spatial Fourier transform of the electron distribution in a plasma is obtained, together with its time variation, using assumptions consistent with an ionospheric application.

537.56 **1460**

Space-Charge Instabilities in Synthesized Plasmas.—A. L. Eichenbaum & K. G. Hernqvist. (*J. appl. Phys.*, Jan. 1961, Vol. 32, No. 1, pp. 16–21.) Potential transitions, dependent on boundary space-charge conditions, are shown to be possible by a theoretical analysis of an idealized model. Such transitions are observed experimentally. The voltage jumps are in good agreement with the theory.

537.56 **1461**

Method for the Determination of the Electron Density of a Plasma by Group Velocity.—T. Consoli & D. Lepechinski. (*C. R. Acad. Sci., Paris*, 11th April 1960, Vol. 250, No. 15, pp. 2694–2696.)

537.56 **1462**

Method of Measuring Simultaneously the Confining Magnetic Field and the Electron Density of a Plasma.—T. Consoli & D. Lepechinski. (*C. R. Acad. Sci., Paris*, 20th April 1960, Vol. 250, No. 16, pp. 2813–2815.) Extension of earlier work (1461 above).

537.56: 538.561.029.64 **1463**

Microwave Measurements of the Radiation Temperature of Plasmas.—G. Bekefi & S. C. Brown. (*J. appl. Phys.*, Jan. 1961, Vol. 32, No. 1, pp. 25–30.) Measurements are described of radiation temperature of positive columns of glow discharges in helium, neon and hydrogen; the microwave noise radiation was detected at 3 Gc/s. The results are compared with calculations and with Langmuir probe measurements of the electron temperature.

537.56: 538.566] + 621.391.812.63 **1464**

Nonlinear Phenomena in a Plasma Located in an Alternating Electromagnetic Field.—V. L. Ginzburg & A. V. Gurevich. (*Usp. fiz. Nauk*, Feb. & March 1960, Vol. 70, Nos. 2 & 3, pp. 201–246 & 393–428.) A detailed treatment of elementary and kinetic theories of a nonrelativis nondegenerate plasma in a uniform elec ric field, with particular reference to the distribution function of electron collisions, the effective electron temperature and total electric current density. Results are applied to determine the nonlinear effects occurring in the propagation of radio waves in the ionosphere, including self-interaction, cross-modulation and the interaction of unmodulated waves. 133 references.

537.56: 538.63 **1465**

Oscillations and Diffusion in Weakly Ionized Plasmas.—J. F. Bonnal, G. Briffod & C. Manus. (*C. R. Acad. Sci., Paris*, 25th April 1960, Vol. 250, No. 17, pp. 2859–2861.) The diffusion of weakly ionized plasma particles is observed in a direction perpendicular to the magnetic field.

538.11 **1466**

Magnetic Moment and Magnetic Charge.—J. Fischer. (*Arch. Elektrotech.*, 11th April 1960, Vol. 45, No. 3, pp. 157–161.) The definition of magnetic dipole moment and magnetic charge in relation to the theory of permanent magnets is discussed.

538.114/.115 **1467**

Some Properties of Concentrated and Dilute Heisenberg Magnets with General Spin.—R. J. Elliott. (*J. Phys. Chem. Solids*, Nov. 1960, Vol. 16, Nos. 3/4, pp. 165–163.) The constant coupling approximation is used to obtain the thermodynamic properties of a Heisenberg ferromagnet above the transition temperature, and the dependence of these properties on magnetic concentration in an alloy is considered. Antiferromagnets are also discussed.

538.114/.115 **1468**

The Behaviour of Magnetic Systems with Dilution.—J. S. Smart. (*J. Phys. Chem. Solids*, Nov. 1960, Vol. 16, Nos. 3/4, pp. 169–173.) Generalization of the Bethe-Peierls-Weiss method to the case of alloys, and application to the dilution of classical Heisenberg ferromagnets with nearest-neighbour interaction only.

538.222: 538.569.4: 538.614 **1469**

Microwave Modulation of Light in Paramagnetic Crystals.—N. Bloembergen, P. S. Pershan & L. R. Wilcox. (*Phys. Rev.*, 15th Dec. 1960, Vol. 120, No. 6, pp. 2014–2023.) The considerations of Dehmelt and others about the modulation of light by r.f. signals in atomic vapours are extended to paramagnetic solids. Experimental design criteria are discussed and some possible applications reviewed.

538.24 **1470**

Anisotropic Magnetization.—E. R. Callen & H. B. Callen. (*J. Phys. Chem. Solids*, Nov. 1960, Vol. 16, Nos. 3/4, pp. 310–328.) Discussion of the magnitude and temperature dependence of anisotropic magnetization, with application to different classes of materials.

538.566 **1471**

Electromagnetic Energy Density in Dispersive Media.—F. Borgnis. (*Z. Phys.*, 16th May 1960, Vol. 159, No. 1, pp. 1–6.) General expressions for energy densities and losses are derived.

538.566: 535.31: 534.512.2 **1472**

Electromagnetic Reflection from Sound Waves.—Schmitt & Wu. (See 1387.)

538.566: 535.42 **1473**

Inhomogeneous Waves in the Diffraction Field near Loss-Free Dielectric Circular Cylinders.—V. Müller. (*Z. angew. Phys.*, May 1960, Vol. 12, No. 5, pp. 206–212.) Measurements were made at 3·2 cm λ of the diffraction field near solid and hollow dielectric cylinders of equal external diameter placed in a parallel-plate transmission line. Results are compared with those obtained for a solid metal cylinder of equal diameter and with the field distribution given by a graphical method. An explanation is given of the origin and structure of the inhomogeneous waves which contribute to the measured diffraction field.

538.566: 535.42 **1474**

Diffraction by an Irregular Screen of Limited Extent.—B. H. Briggs. (*Proc. phys. Soc.*, 1st Feb. 1961, Vol. 77, No. 494, pp. 305–317.) Information that may be derived about the screen by measurements of the diffraction pattern at different distances is considered. Close to the screen the

pattern gives information about the small-scale structure; at greater distances it is related to the overall extent of the screen. Measurements of the angular diameter of stars, ionospheric irregularities and meteor trails are discussed.

538.566 : 535.42 **1475**

Diffraction by Finite Irregular Objects.—R. P. Mercier. (*Proc. phys. Soc.*, 1st Feb. 1961, Vol. 77, No. 494, pp. 318–327.) The problem considered in 1474 above is treated by a different method. Its application to lunar radio echoes is discussed.

538.566 : 537.56 **1476**

Nonresonance Absorption of Electromagnetic Waves in a Magnetoactive Plasma.—B. N. Gershman. (*Zh. eksp. teor. Fiz.*, Sept. 1959, Vol. 37, No. 3 (9), pp. 695–704.) Analysis of the absorption of ordinary, extraordinary and plasma waves outside the gyromagnetic resonance regions, taking account of collisions and the specific absorption mechanism.

538.566 : 537.56 **1477**

Growth of Electromagnetic Waves in Interpenetrating Infinite Moving Media.—G. G. Getmantsev. (*Zh. eksp. teor. Fiz.*, Sept. 1959, Vol. 37, No. 3 (9), pp. 843–846.) Phenomenological treatment of the propagation of plane monochromatic waves in mutually interpenetrating media. Equations are derived for the refractive index and are applied to the problem of stability. Build-up and damping factors are determined for the case of a plasma moving through a dispersionless dielectric.

538.566.2 : 539.23 **1478**

***Influence of Frequency and Structure* on the Complex Refractive Index of Metals and Thin Metallic Films.**—M. Gourceaux. (*C. R. Acad. Sci., Paris*, 21st March 1960, Vol. 250, No. 12, pp. 2176–2178.) Extension of earlier work (3651 of 1959).

538.569.2 **1479**

Quantum Theory of Spatial Dispersion of Electric and Magnetic Susceptibilities.—O. V. Konstantinov & V. I. Perel'. (*Zh. eksp. teor. Fiz.*, Sept. 1959, Vol. 37, No. 3 (9), pp. 786–792.) Electromagnetic effects in a homogeneous medium can be described in terms of a conductivity dependent on frequency and wave vector, and a susceptibility dependent only on the wave vector. A universal relation between conductivity and susceptibility is derived.

538.569.4 **1480**

The Influence of Coherent Magnetic-Dipole Radiation Field on Magnetic Resonance.—G. V. Skrotskiĭ & A. A. Kokin. (*Zh. eksp. teor. Fiz.*, Sept. 1959, Vol. 37, No. 3 (9), pp. 802–804.) Corrections to the relaxation time and resonance-frequency shift due to the effect of the radiation field are computed.

538.569.4 : 535.33 : 621.375.9 **1481**

Beam-Type Masers for Radio-Frequency Spectroscopy.—K. Shimoda, H. Takuma & T. Shimizu. (*J. phys. Soc. Japan*, Nov. 1960, Vol. 15, No. 11, pp. 2036–2041.) The behaviour of the beam-type maser is considered theoretically, with particular regard to sensitivity and line width. Experimental results for a formaldehyde transition are given for comparison.

538.569.4 : 538.22 **1482**

General Spin-Wave Dispersion Relations.—R. F. Soohoo. (*Phys. Rev.*, 15th Dec. 1960, Vol. 120, No. 6, pp. 1978–1982.) The derivation takes into account the effects of conductivity, exchange and propagation.

538.569.4 : 538.221 : 621.318.134 **1483**

Calculation of the Widths of Ferrimagnetic Absorption Lines and of Relaxation Times in the Case of Spin Waves of Non-negligible Amplitude.—P. E. Seiden. (*C. R. Acad. Sci., Paris*, 4th April 1960, Vol. 250, No. 14, pp. 2530–2532.)

538.569.4 : 538.222 **1484**

Pulsed-Field Measurements of Large Zero-Field Splittings. V^{2+} in Al_2O_3.—S. Foner & W. Low. (*Phys. Rev.*, 1st Dec. 1960, Vol. 120, No. 5, pp. 1585–1588.)

538.569.4 : 539.2 : 621.373.421.1 **1485**

The Hamiltonian Formalism of Damping in a Tuned Circuit.—Stevens. (See 1439.)

538.569.4 : 621.375.9 : 535.61-1.2 **1486**

Proposed Fibre Cavities for Optical Masers.—E. Snitzer. (*J. appl. Phys.*, Jan. 1961, Vol. 32, No. 1, pp. 36–39.) The practical possibilities of employing fibres as dielectric waveguides at optical infrared wavelengths are discussed.

539.2 : 537.112 **1487**

Electron Effective Mass in Solids—a Generalization of Bardeen's Formula.—M. H. Cohen & F. S. Ham. (*J. Phys. Chem. Solids*, Nov. 1960, Vol. 16, Nos. 3/4, pp. 177–183.) "A formula is derived for the effective mass of an electron in a crystal which replaces the sum over excited states in the usual sum rule by an integral over the surface of the unit cell. The integrand of the surface integral involves the wave function(s) at the symmetry point or band extremum k_0 and a second solution of Schroedinger's equation at the same energy but satisfying inhomogeneous boundary conditions on the cell surface."

GEOPHYSICAL AND EXTRATERRESTRIAL PHENOMENA

523.12 **1488**

An All-Electric Universe.—C. E. R. Bruce. (*Elect. Rev., Lond.*, 23rd Dec. 1960, Vol. 167, No. 26, pp. 1070–1075.) Outline of theory ascribing the evolution of the universe to electrical discharge processes. An interpretation is given of observed cosmic phenomena. Correction, *ibid.*, 6th Jan. 1961, Vol. 168, No. 1, p. 20.

523.15 **1489**

The Theory of Force-Free Magnetic Fields.—E. Richter. (*Z. Phys.*, 15th June 1960, Vol. 159, No. 2, pp. 194–211.) The general features of force-free magnetic fields are established and several models are discussed in relation to special coordinate systems. See also 784 of 1959 (Woltjer).

523.164.3 **1490**

A Curious Feature of the Radio Sky.—R. H. Brown, R. D. Davies & C. Hazard. (*Observatory*, Oct. 1960, Vol. 80, No. 948, pp. 191–198.) An examination of existing theories regarding the spur of intense radiation which appears to emerge from the galactic plane at about $l^{II} = 30°$ and to run upwards towards the north galactic pole. Radio observations may be interpreted more reasonably in terms of an irregularity in the local spiral structure or a remnant of a supernova.

523.164.3 **1491**

Observations of Cosmic Radio Noise at 18 Mc/s in Hawaii.—W. R. Steiger & J. W. Warwick. (*J. geophys. Res.*, Jan. 1961, Vol. 66, No. 1, pp. 57–66.) Cosmic radio noise measurements at Hawaii on a frequency of 18 Mc/s are described. On numerous occasions considerable flux continued to arrive when the F-region critical frequency exceeded 18 Mc/s. This effect is possibly due to cosmic radio radiation being trapped and propagated under the ionosphere. Attenuation measurements suggest that an ionospheric window effect exists.

523.164.3 **1492**

Secular Variation of the Flux Density of the Radio Source Cassiopeia A.—J. A. Högbom & J. R. Shakeshaft. (*Nature, Lond.*, 18th Feb. 1961, Vol. 189, No. 4674, pp. 561–562.) Comparative measurements at 81·5 Mc/s on the r.f. sources in Cassiopeia A and Cygnus A indicate that the flux density of Cassiopeia A is decreasing at a rate of (1·06 ± 0·14)% per annum.

523.164.3 : 551.510.535 **1493**

Statistical Analysis of Radio Star Scintillation.—S. Gruber. (*J. atmos. terr. Phys.*, Feb. 1961, Vol. 20, No. 1, pp. 59–71.) "Radio star scintillation data are analysed by statistical techniques to find the auto-correlation functions and power density spectra of the fluctuations in amplitude and phase. Interpretation is given in terms of a drifting phase-changing screen as postulated by Booker, Ratcliffe & Shinn [428 of 1951]. It is shown how the drift velocity of the irregularities in ionospheric electron density that lead to the scintillations, as well as the mean square amplitude and phase of the fluctuations, may be obtained from these records."

523.164.32 **1494**

Preliminary Report on Positional Fluctuations of Solar Radio Sources on 200 Mc/s.—P. Maltby. (*Astrophys. norveg.*, Dec. 1958, Vol. 6, No. 7, pp. 75–84.) An analysis indicates that the magnitude of the positional fluctuations is less when the solar r.f. source is closely connected with a magnetic field in the active region. No increase in the magnitude of positional fluctuations was found on 200 Mc/s as the source moved towards the solar limb.

523.164.32 **1495**

On the Features of Storm Bursts in the 200-Mc/s Range.—O. Elgarøy & O. Hauge. (*Astrophys. norveg.*, Dec. 1958, Vol. 6, No. 8, pp. 85–92.) The characteristics of 'short pips' which occur during noise storms are discussed. For brief reports of this work see 1140 and 1141 of 1958 (Elgarøy).

523.164.32: 523.75 **1496**

10.7-cm Solar Noise Burst of November 20, 1960.—A. E. Covington & G. A. Harvey. (*Phys. Rev. Lett.*, 15th Jan. 1961, Vol. 6, No. 2, pp. 51–52.) A burst of r.f. noise of high intensity is associated with a flare from a sunspot area which had just disappeared behind the sun's west limb.

523.165 **1497**

Mirror and Azimuthal Drift Frequencies for Geomagnetically Trapped Particles.—D. A. Hamlin, R. Karplus, R. C. Vik & K. M. Watson. (*J. geophys. Res.*, Jan. 1961, Vol. 66, No. 1, pp. 1–4.) "For charged particles trapped in the geomagnetic field, the frequencies of the mirror oscillations ω_m and the azimuthal drift ω_d are defined as appropriate averages over the helical motion around the field lines and the mirror motion between reflection points in the two magnetic hemispheres. These integrals for ω_m and ω_d are evaluated numerically. Results are tabulated, illustrated, and represented by approximate analytical expressions."

523.165: 551.507.362 **1498**

Investigation of Cosmic Rays and Terrestrial Corpuscular Radiation by means of Rocket and Satellite Flights.—S. N. Vernov & A. E. Chudakov. (*Usp. fiz. Nauk*, April 1960, Vol. 70, No. 4, pp. 585–619.) Detailed report of observations showing that the earth is surrounded by two separate zones of high-intensity radiation. The outer zone is composed of electrons and in the equatorial plane extends from 20 000 to 60 000 km from the centre of the earth. It comprises two main energy groups of the order of 20 keV and 10 MeV. The inner zone extends from 600 km to about 6 000 km above the earth and is composed of protons with energies of 10 MeV. See also 1594 and 3086 of 1960 (Vernov et al.).

523.75: 523.165 **1499**

The Cosmic-Ray Flare on November 12, 1960 and Solar Activity during the Period November 10–15, 1960.—(*Nature, Lond.*, 11th Feb. 1961, Vol. 189, No. 4763, pp. 438–440.) Short report of optical, radio-astronomical, cosmic-ray and earth-current observations made at Nera (Netherlands), Paramaribo (Surinam) and Hollandia (New Guinea).

550.38: 551.594.5 **1500**

Interplanetary Magnetic Field and the Auroral Zones.—J. W. Dungey. (*Phys. Rev. Lett.*, 15th Jan. 1961, Vol. 6, No. 2, pp. 47–48.) The S_D current system is explained qualitatively using Hoyle's suggestion that auroral particles are accelerated at the neutral points between the geomagnetic and interplanetary fields.

550.385 **1501**

Pulsations of the Earth's Electromagnetic Field with Periods of 1 to 15 Seconds and their Connection with Phenomena in the High Atmosphere.—V. A. Troitskaya. (*J. geophys. Res.*, Jan. 1961, Vol. 66, No. 1, pp. 5–18.) Pulsations are closely correlated with aurora and the various phases of magnetic storms. The time of onset of a storm sudden commencement determined from pulsation data appears to be the same, within a few seconds, over the whole world. See 133 of 1960 (Troitskaya & Mel'nikova).

550.385.3 **1502**

World-Wide Characteristics of Geomagnetic Micropulsations.—J. A. Jacobs & K. Sinno. (*Geophys. J. R. astr. Soc.*, Sept. 1960, Vol. 3, No. 3, pp. 333–353.) The characteristics of *Pi*'s associated with negative or positive bays in the auroral zone are examined and a distinction is drawn between short-period *Pi*'s (15–30 sec) and those of longer periods (30–90 sec). The long-period, continuous pulsations which appear simultaneously with *Pi*'s in polar regions are also discussed. Equivalent overhead current systems are derived for particular cases of each type.

550.385.4 **1503**

A Theory of Polar Geomagnetic Storms.—J. H. Pebbington. (*Geophys. J. R. astr. Soc.*, Sept. 1960, Vol. 3, No. 3, pp. 314–332.) The third of a series of papers which outline a hydromagnetic theory of storms (see 1209 and 1993 of 1960). The three phases of the D_{st} variations are accounted for by Hall currents set up around space-charge accumulations in the lower ionosphere. These accumulations result from the deformation of lines of force due to interaction with the solar wind near 06 and 18 hr local time.

551.507.362.2: 621.391.812.63 **1504**

The Application of Ray Tracing Methods to Radio Signals from Satellites.—Capon. (See 1624.)

551.507.362.2: 621.396 **1505**

Project Oscar.—D. L. Stoner. (*QST*, Feb. 1961, Vol. 45, No. 2, pp. 56–59 146.) General information is given about a proposed 'orbital satellite carrying amateur radio'.

551.507.362.2: 621.398: 621.3.087.4 **1506**

Telemetry Signals from Sputnik III.—R. E. Henderson. (*Electronic Technol.*, March 1961, Vol. 38, No. 3, pp. 76–79.) The equipment transcribes from magnetic tape to 35-mm film, displaying the coded pulse signals in a raster form which clearly shows pattern changes. The telemetry coding system is given and two transits are analysed.

551.510.535 + 550.38 **1507**

Scale Times and Scale Lengths of Variables: with Geomagnetic and Ionospheric Illustrations.—S. Chapman. (*Proc. phys. Soc.*, 1st Feb. 1961, Vol. 77, No. 494, pp. 424–432.) The conception of the atmospheric scale height is generalized to apply to any scalar or vector function of time and or position. Examples are given relating to magnetic fields and the ionosphere.

551.510.535 **1508**

A Maximum of Temperature in the Middle Ionosphere.—O. Burkard. (*Nature, Lond.*, 11th Feb. 1961, Vol. 189, No. 4763, p. 476.) A method is outlined for determining variations in scale height H and electron density with height from $N(h)$ profiles and from calculations of the electron loss. Results obtained from observations at Puerto Rico show that H has a maximum value at a height of about 200 km, with considerable daily and yearly variations. See 3705 of 1959.

551.510.535 **1509**

A New Method for the Calculation of $N(h)$ Profiles from Ionospheric $h'(f)$ Curves.—H. Hoyo. (*Nature, Lond.*, 18th Feb. 1961, Vol. 189, No. 4764, pp. 562–563.) The basic integral for virtual height has been rearranged so that the integrand is a function of phase refractive index instead of group refractive index. This technique avoids an infinity in the integrand at the reflection condition.

551.510.535 **1510**

The Effective Recombination Coefficient of an Ionosphere Containing a Mixture of Ions.—S. A. Bowhill. (*J. atmos. terr. Phys.*, Feb. 1961, Vol. 20, No. 1, pp. 19–30.) The effective recombination coefficient in the E layer can be estimated from the fall in electron density during the night, from the changes during solar eclipses, from the time lag in the diurnal peak density. These coefficients can be expressed as functions of the coefficients for each of several different ions present and are shown to be different from each other. It is suggested that O_2^+ and NO^+ are the ions responsible during the day, and that NO^+ ions predominate at night.

551.510.535 **1511**

The Formation of the Sporadic-E Layer in the Temperate Zones.—J. D. Whitehead. (*J. atmos. terr. Phys.*, Feb. 1961, Vol. 20, No. 1, pp. 49–58.) A hypothesis for E_s formation based on the observation that E_s occurrence is correlated with the horizontal intensity of the earth's field ([see 3501 of 1960 (Heisler & Whitehead)]. If the horizontal wind varies vertically, the horizontal field will produce vertical motion of electrons and ions. An accumulation of electrons will occur at the height for which the vertical velocity passes through zero. The theory also accounts for the persistence of E_s.

551.510.535 **1512**

Seasonal Variations of Mean Electron Density at Heights between 400 and 1 200 km.—L. Klinker, K. H. Schmelovsky & R. Knuth. (*Naturwissenschaften*, May 1960, Vol. 47, No. 9, pp. 197–148.) Electron-density profiles are given for summer 1958 and winter 1958/1959 which are based on observations of Faraday fading of 20-Mc/s signals from satellite 1958 δ_2.

551.510.535: 539.16 **1513**

A Note on the Cause of Sudden Ionization Anomalies in Regions Remote from High-Altitude Nuclear Bursts.—C. M. Crain & P. Tamarkin. (*J. geophys. Res.*, Jan. 1961, Vol. 66, No. 1, pp. 35–39.) The sudden changes in v.l.f. propagation characteristics associated with the nuclear explosions over Johnston Island are attri-

buted to bomb-induced ionization in the ionospheric D layer. It is suggested that this ionization is caused by β particles resulting from the decay of fission neutrons.

551.510.535 : 550.385.4 **1514**

Geomagnetic Disturbance Effects in Equatorial E_s.—B. N. Bhargava & R. V. Subrahmanyan. (*J. atmos. terr. Phys.*, Feb. 1961, Vol. 20, No. 1, pp. 81–84.) A correlation between the disappearance of equatorial E_s observed at Kodaikanal, India, and magnetic-storm disturbances is reported. A lowered E_s critical frequency occurs with a decrease in horizontal magnetic force.

551.510.535 : 550.385.4 **1515**

The Total Electron Content of the Ionosphere during the Magnetic Disturbance of November 12–13, 1960.—G. N. Taylor. (*Nature, Lond.*, 4th March 1961, Vol. 189, No. 4766, pp. 740–741.) Measurements of the total electron content (n_T) of the ionosphere have been made with the radio telescope at Jodrell Bank by observing the differential Faraday fading of lunar radio echoes. Results show that the reduction in maximum electron density (N_m) was accompanied by a proportional reduction in n_T.

551.510.535 : [551.594.5 + 550.385.37 **1516**

Ionospheric Absorption at Times of Auroral and Magnetic Pulsations.—W. H. Campbell & H. Leinbach. (*J. geophys. Res.*, Jan. 1961, Vol. 66, No. 1, pp. 25–34.) Variations in auroral absorption during March and April 1960, were closely related to magnetic-field micropulsations and short-period intensity changes at 3 914 Å. The amplitudes of the magnetic micropulsations were diminished during periods of polar-cap-type absorption.

551.510.535(98) : 523.164.3 **1517**

A Note on Polar Blackouts.—T. M. Donahue. (*J. atmos. terr. Phys.*, Feb. 1961, Vol. 20, No. 1, pp. 76–79.) The twilight effects in polar-cap blackouts are explained in terms of the detachment of electrons from negative oxygen ions in the region of 50 km and higher by visible light which has been attenuated in the atmosphere.

551.510.535 "1960" **1518**

Ionosphere Review: 1960.—T. W. Bennington. (*Wireless World*, March 1961, Vol. 67, No. 3, pp. 135–136.) Declining sunspot activity forced signal frequencies down.

551.510.536: 551.594.6 **1519**

An Estimate of Electron Densities in the Exosphere by means of Nose Whistlers.—J. H. Pope. (*J. geophys. Res.*, Jan. 1961, Vol. 66, No. 1, pp. 67–75.) By examining successive members of families of nose whistlers for 19th March 1959, it was possible to choose between three models of electron density distribution for the exosphere. The distribution with the best fit was $N = AR^{-n} \exp[3{\cdot}03(R)]$, where N is electron density, R is the distance from the earth's centre and B is a constant. This fact suggests that the density at 5 earth radii is of the order of 10 electrons/cm^3.

551.594.5 **1520**

A Study of Auroral Corpuscles.—W. H. Campbell & M. H. Rees. (*J. geophys. Res.*, Jan. 1961, Vol. 66, No. 1, pp. 41–55.) Corpuscles represent 5% of the total light in the 3 914-Å region and have a period of 6–10 sec. They are closely related to micropulsations and ionospheric absorption of cosmic radio noise. The electron density profile associated with the aurora was found to have a maximum in the E region of $1{\cdot}1 \times 10^6$ electrons/cm^3.

551.594.6 **1521**

Spaced Observations of the Low-Frequency Radiation from the Earth's Upper Atmosphere.—G. R. A. Ellis. (*J. geophys. Res.*, Jan. 1961, Vol. 66, No. 1, pp. 19–23.) "Observations of 5 kc/s radio noise with a network of four stations extending across southern Australia are described. It is shown that there is often good correlation of the amplitude variations over a distance of 3 000 km and that the observed amplitude differences may be explained by assuming that the radiation propagates in the earth-ionosphere waveguide from geographically large sources. Some discrete sources were observed."

551.594.6 **1522**

Sferics from Intracloud Lightning Strokes.—L. R. Tepley. (*J. geophys. Res.*, Jan. 1961, Vol. 66, No. 1, pp. 111–123.) The experimental observation that many e.l.f. atmospherics are of negative polarity indicate that intracloud lightning strokes radiate significant energy at very low and extra low frequencies. See also 1628 of 1960.

551.594.6: 559.16 **1523**

The Magnetic Flash of the Nuclear Test of 13th February 1960 at Reggane.—J. Dufour. (*C. R. Acad. Sci., Paris*, 4th April 1960, Vol. 250, No. 14, pp. 2536–2537.) An e.m. signal originating in the explosion at Reggane has been recorded with a field strength of 0·1 V/m at a distance of 2 500 km.

LOCATION AND AIDS TO NAVIGATION

621.396.933 : 621.391.66 **1524**

Infrared Scanners for Airborne Reconnaissance.—C. M. Cade. (*Brit. Commun. Electronics*, Feb. 1961, Vol. 8, No. 2, pp. 94–102.) The advantages of infrared scanning systems are compared with those of radar scanners. The practical problems of system design are given detailed consideration.

621.396.933.23 **1525**

Radio Guidance Elements of the B.L.E.U. Automatic Landing System for Aircraft.—J. S. Shawler. (*J. Brit. Instn Radio Engrs*, Jan. 1961, Vol. 21, No. 1, pp. 17–35. Discussion.) A detailed description is given of the magnetic leader cable and Doppler radio altimeter equipment used during the final stages of an automatic landing.

621.396.96: 629.13.052 **1526**

Electrical Measurement of Altitude: Part 2—Physical Fundamentals.—H. J. Zeitemann. (*Arch. tech. Messen*, March 1960, No. 296, pp. 61–66.) Part 1 : 570 of February.

621.396.963 : 621.3.037.4 **1527**

Development and Possible Applications of Equipment for Bandwidth Compression of Radar Signals by means of Storage Capacitors.—K. Jekelius. (*Nachrichtentech. Z.*, May 1960, Vol. 13, No. 5, pp. 225–233.) The problem of storage-system design for radar relay links is considered, and the requirements of such a relay system regarding resolving power and transmission bandwidth are assessed with reference to tabulated data of several radar systems. Equipment for radar-picture transmission over long distances using channels of narrow bandwidth is described.

621.396.963 : 681.142 **1528**

Preparation of Radar Data for High-Speed Digital Computers.—R. R. Fidler, R. B. Angus, Jr., & P. F. Marino. (*Sylvania Technologist*, July 1959, Vol. 12, No. 3, pp. 97–105.) Common mathematical equations-to-solve problems are studied and a brief description is given of an implementation of the results for the case of a signal in continuous random noise.

621.396.963.3–621.397.331.28 **1529**

An Experimental Scan Conversion System for the Production of Bright Radar Displays.—D. L. Plaistow. (*Marconi Rev.*, 4th Quarter 1960, Vol. 23, No. 139, pp. 188–205.) An experimental investigation is described into the reproduction characteristics of a twin-gun tube in which a radar image is scanned by an electron beam to produce a brightened image on a standard television picture tube.

621.396.967.2 **1530**

The Elbe-Weser Short-Range Radar System.—C. le Coupe, O. Hiller, J. M. G. Seppen & W. J. Verhoeff. (*Philips. tech. Rdsch.*, 1960, Vol. 22, No. 2, pp. 39–105. In English.) A description is given of the radar system and associated equipment.

621.396.969 : 551.578.7 **1531**

Radar Scatter by Large Hail.—D. Atlas, W. G. Harper, F. H. Ludlam & W. C. Macklin. (*Quart. J. R. met. Soc.*, Oct. 1960, Vol. 86, No. 370, pp. 468–482.) Radars with wavelengths of 3·3 and 4·67 cm have been used to measure the back-scatter cross-sections of individual artificial hailstones and their variations as melting occurs. Results confirm the cross-sections computed theoretically.

MATERIALS AND SUBSIDIARY TECHNIQUES

535.215 **1532**

Photoelectric Effect in Ag–As–Se Glasses.—H. Kallo & M. Ojebo. (*Bull. tech. Univ. Istanbul*, 1960, Vol. 13, No. 1, pp. 1–31.) Report of photoelectric measurements on different alloys formed by mixing Ag_2S and As_2Se_3 compounds in varying proportions. Curves of photocurrent as a function of illumination intensity and time are given and discussed.

535.215 **1533**

Investigations on Cs-Sb Films.—C. Kumar. (*Ann. Phys., Lpz.*, 21st May 1960, Vol. 6, Nos. 1/2, pp. 89–106.) Optical and electrical measurements were carried out on Cs-Sb films of different composition and the results relating to absorption, conductivity and spectral distribution of the photo-effect are discussed with reference to the results of other authors. 44 references.

535.215: 537.533.8 **1534**

Secondary Electron Emission of Antimony-Caesium and Bismuth-Caesium Films of Different Composition.—G. Appelt & O. Hachenberg. (*Ann. Phys., Lpz.*, 21st May 1960, Vol. 6, Nos. 1/2, pp. 67–81.)

535.215: 537.533.8 **1535**

Secondary Electron Emission of Antimony-Rubidium Films.—W. Kanoff. (*Ann. Phys., Lpz.*, 21st May 1960, Vol. 6, Nos. 1/2, pp. 62–66.)

535.215: 546.48'221'261 **1536**

Photoconductivity of Cu-Activated Cadmium Sulphide-Selenide.—S. Ivanov. (*J. phys. Soc. Japan*, Nov. 1960, Vol. 15, No. 11, p. 2103.)

535.215: 546.48'261 **1537**

On the Electrical and Optical Properties of p-Type Cadmium Telluride Crystals.—S. Yamada. (*J. phys. Soc. Japan*, Nov. 1960, Vol. 15, No. 11, pp. 1960–1966.) From measurements of optical transmission and Hall coefficient of p-type CdTe single crystals, the energy gap is found to be about 1·45 eV, the ionization energy of acceptors about 0·1 eV, and the Hall mobility of holes about 80 cm²/V · sec at room temperature.

535.215: 546.817'221 **1538**

Electrical Structure of PbO Films.—D. P. Snowden & A. M. Portis. (*Phys. Rev.*, 15th Dec. 1960, Vol. 120, No. 6, pp. 1983–1995.) Electrical properties have been investigated experimentally as a function of frequency from zero to the microwave range. Data are compared with calculations based on a proposed model.

535.37 **1539**

The Activated Calcium Orthosilicate Phosphors.—R. W. Mooney. (*J. electrochem. Soc.*, Feb. 1960, Vol. 107, No. 2, pp. 103–108.)

535.376 **1540**

Electroluminescence of Insulated Particles: Part 2.—G. Mavrin. (*J. phys. Soc. Japan*, Nov. 1960, Vol. 15, No. 11, pp. 2051–2058.) The theory given in Part 1 (1535 of 1959) is shown to be consistent with recent experimental data.

537.226: 546.431'824.31 **1541**

Study of Solid-Solution Single Crystals containing $BaTiO_3$.—T. Sakudo. (*J. phys. Soc. Japan*, Nov. 1960, Vol. 15, No. 11, pp. 2153–2158.) Dielectric and optical properties of various $BaTiO_3$ and $BaTiO_3$ titanates have been measured.

537.226: 621.315.6 **1542**

Silicon Dioxide Thin-Film Dielectrics.—C. H. Bartow & C. R. Crowell. (*J. electrochem. Soc.*, Feb. 1960, Vol. 107, No. 2, pp. 97–102.) Thin films of Si_3N_4 have been deposited pyrolytically on hot Mo substrates to form capacitors capable of operating satisfactorily in the region of 600°C.

537.226.2: 546.824.31 **1543**

Dielectric Constant and Dielectric Loss of TiO_2 (Rutile) at Low Frequencies.—R. A. Parker & J. H. Wasilik. (*Phys. Rev.*, 1st Dec. 1960, Vol. 120, No. 5, pp. 1631–1637.) A rise in dielectric constant from 170 at 1 Mc/s to 30 000 at 10 c/s is confirmed. This is explained in terms of an electron-deficient barrier layer of variable thickness.

537.227 **1544**

Ferroelectricity.—C. F. Pulvari. (*Phys. Rev.*, 1st Dec. 1960, Vol. 120, No. 5, pp. 1670–1673.) A new group of materials with ferroelectric properties has been found. They are mixed crystals of antiferroelectric compounds, e.g. $Na(V_xNb_{1-x})O_3$ or $(Na_{1-x}Mg_x/2)NbO_3$. The onset of the ferroelectric state is a function of the applied field. Switching transients of a form not previously reported are shown.

537.227 **1545**

Electrical Properties of Lead-Barium-Niobates and Associated Materials.—P. Burdett & N. J. Hellicar. (*J. Amer. ceram. Soc.*, Nov. 1960, Vol. 43, No. 11, pp. 579–585.)

537.227 **1546**

Ferroelectric Properties of $Ba_2(Li_{1-x}Nb_{1+x})O_{6-3x}$.—E. G. Dixon & S. K. Swoope. (*Phys. Rev.*, 15th Dec. 1960, Vol. 120, No. 6, pp. 1949–1954.) Experimental data on a new type of room-temperature ferroelectric are given. A preliminary study of switching properties shows a switching time $\tau < 3\,\mu s$ for 300-V pulses applied to a crystal 0·1 mm thick.

537.227: 546.431'824.31 : 621.317.335.3 **1547**

Measurement of Microwave Dielectric Constants of Ferroelectrics: Part 1 —Dielectric Constants of Ba_2TiO_3 Single Crystal at 3·14 Gc/s.—E. Nakamura & J. Furuichi. (*J. phys. Soc. Japan*, Nov. 1960, Vol. 15, No. 11, pp. 1915–1960.) S-band measurements of the dielectric constant (including loss) of Ba_2TiO_3 single crystals by a resonant-cavity perturbation method are described (see 966 of 1960 (Hamer et al.)). Results are given for temperatures from 20 to 170°C.

537.311.33 **1548**

Kinetic Theory of Impact Ionization in Semiconductors.—L. V. Keldysh. (*Zh. eksp. teor. Fiz.*, Sept. 1958, Vol. 37, No. 3 (9), pp. 713–727.) The energy dependence of the impact ionization probability near the threshold is significantly different for crystals with low and with high dielectric constants. The solution of the kinetic equations is considered in the two cases. Expressions are derived for the equilibrium number of carriers in a strong field, the impact ionization coefficient and the critical field strength. Increasing the electric field leads to a decrease in the recombination velocity and as a result the equilibrium number of carriers begins to increase long before the appearance of impact ionization.

537.311.33 **1549**

Determination of Numbers of Injected Holes and Electrons in Semiconductors.—F. van der Maesen. (*Philips Res. Rep.*, April 1960, Vol. 15, No. 2, pp. 107–119.) Measurements of the photoelectric Hall effect and photoconduction may give information on the deviations of the equilibrium numbers of holes and electrons. The ratio of these deviations is used in computing the diffusion-recombination length. The ratio of Hall mobility to drift mobility for electrons and holes is evaluated for Ge and Si.

537.311.33 **1550**

The p-n Junction in a Temperature Gradient.—W. Kinze. (*Ann. Phys., Lpz.*, 21st May 1960, Vol. 6, Nos. 1/2, pp. 25–30.) The problem of the nonisothermal junction is treated theoretically and the energy transport across the junction is calculated. The possibilities of experimental verification are considered.

537.311.33 **1551**

A Theory of the Effects of Carrier-Carrier Scattering on Mobility in Semiconductors.—T. P. McLean & E. G. S. Paige. (*J. Phys. Chem. Solids*, Nov. 1960, Vol. 16, Nos. 3/4, pp. 220–236.) The theory given is valid at low temperatures where carrier-carrier scattering is most important. Electron-hole scattering can produce the largest effects, altering both the mobility and its temperature dependence. In some cases the opposite drift velocities of electrons and holes can produce a drag effect which is sufficient to give minority carriers a negative mobility.

537.311.33 **1552**

Atomic Radius, Electronegativities and Activation Energies in Mixed Semiconductor Compounds.—J. P. Suchet. (*J. Phys. Chem. Solids*, Nov. 1960, Vol. 16, Nos. 3/4, pp. 265–278. In French.) Empirical relations are deduced between atomic and structural data, and the homopolar and heteropolar contributions to the energy gap, and used to calculate the latter quantities for about a hundred semiconducting binary compounds. See also 2782 of 1960.

537.311.33 **1553**

Uniformity of Electrical Current Flow in Cylindrical Semiconductor Specimens with Cylindrical Metallic End Caps.—R. Simon, J. H. Cafin & J. C. Bell. (*J. appl. Phys.*, Jan. 1961, Vol. 32, No. 1, pp. 46–47.) "The distribution of current is computed in a cylindrical semiconductor specimen provided with cylindrical metallic end caps of the same diameter as that of the specimen and electrical lead wires of much smaller diameter. Nonuniformity of the longitudinal current density of 1% or less can be obtained in specimens with electrical resistivities at least 100 times greater than that of the end caps if the lengths of the specimens are at least equal to their diameters and if the length of each end cap is at least 0·3 the."

537.311.33 **1554**

Theory of Tunnelling.—E. O. Kane. (*J. appl. Phys.*, Jan. 1961, Vol. 32, No. 1,

pp. 83–91.) "The theory of 'direct' and 'phonon-assisted' tunnelling is reviewed. Theoretical *I-V* characteristics are calculated using the constant field model. Generalizations to nonconstant field and more complicated band structure models are discussed briefly."

537.311.33 **1555**

Tunnelling from a Many-Particle Point of View.—J. Bardeen. (*Phys. Rev. Lett.*, 15th Jan. 1961, Vol. 6, No. 2, pp. 57–59.) In the expression for the transition probability $(4\pi^2/h)|M|^2\rho f$, for the case of tunnelling between two metals separated by a thin oxide layer, the matrix element M can be treated as a constant; it is independent of small changes in energy and is also unchanged when the metals pass from the normal to the superconducting state.

537.311.33 **1556**

Thermal Expansion and Related Bonding Problems of some III-V Compound Semiconductors.—L. Bernstein & R. J. Beals. (*J. appl. Phys.*, Jan. 1961, Vol. 32, No. 1, pp. 122–123.)

537.311.33: 535.215 **1557**

Photomagnetoelectric Effect and Photoconductivity in Semiconductors.—V. Andresciani. (*Alta Frequenza*, April 1960, Vol. 29, No. 2, pp. 154–205.) General theoretical treatment of the photomagnetoelectric effect; formulae are derived for the photomagnetoelectric and photoconductivity voltages and currents under conditions of practical interest. Measurements of these voltages and currents and of carrier lifetime were made as a function of the magnetic field on specimens of Ge and Si, and the effects of surface recombination and light spectrum and intensity are assessed.

537.311.33: 546.28 **1558**

Electron Mobilities and Tunnelling Currents in Silicon.—R. A. Logan, J. F. Gilbert & F. A. Trumbore. (*J. appl. Phys.*, Jan. 1961, Vol. 32, No. 1, pp. 131–132.) Hall effect techniques were used to measure carrier density as a function of resistivity in Si samples doped with As, P and Sb in the concentration range used in Esaki diodes. The Hall mobility decreases in the order $\mu(\mathrm{Sb}) > \mu(\mathrm{P}) > \mu(\mathrm{As})$. These differences are not predicted by present theories and possible explanations are discussed.

537.311.33: 546.28 **1559**

Hole and Electron Mobilities in Doped Silicon from Radiochemical and Conductivity Measurements.—K. B. Wolfstirn. (*J. Phys. Chem. Solids*, Nov. 1960, Vol. 16, Nos. 3/4, pp. 279–284.) Calculations of conductivity mobility at 300°K for holes and electrons in Ga-, As- and Sb-doped Si, from electrical and radiochemical measurements, using the effective mass approximation.

537.311.33: 546.28 **1560**

Scattering of Conduction Electrons by Lattice Vibrations in Silicon.—D. Long. (*Phys. Rev.*, 15th Dec. 1960, Vol. 120, No. 6, pp. 2024–2032.) A theoretical model is applied to experimental data to determine how accurately the magnitude and temperature dependence of the various electrical transport effects in nearly pure *n*-type Si can be described by present theoretical ideas about lattice scattering in this material.

537.311.33: 546.28: 537.533 **1561**

Experimental Evidence for the Existence of Two Distinct Field-Emission Characteristics from Silicon Emitters.—R. L. Perry. (*J. appl. Phys.*, Jan. 1961, Vol. 32, No. 1, pp. 128–130.) For the Type 1 relation, the log $I/(10^6/V)$ relation shows a point of inflexion for d.c. and the relation is quite different for pulses. The relations for d.c. and pulses are almost linear for Type 2 data. The methods of production of the two types are discussed briefly.

537.311.33: [546.28 + 546.289] : 538.614 **1562**

Microwave Faraday Effect in Silicon and Germanium.—J. K. Furdyna & S. Broersma. (*Phys. Rev.*, 15th Dec. 1960, Vol. 120, No. 6, pp. 1995–2003.) The Faraday rotation and ellipticity in a system of quasi-free carriers is discussed and applied to microwave measurements on semiconductors. Theoretical expressions are analysed for various ranges of parameters and compared with experimental data.

537.311.33: 546.281'26 **1563**

Grown *p-n* Junctions in Silicon Carbide.—C. A. A. J. Greebe & W. F. Knippenberg. (*Philips Res. Rep.*, April 1960, Vol. 15, No. 2, pp. 120–123.) The preparation and properties are described and the forward characteristics are explained in terms of a *p-i-n* structure. Recombination radiation was found to contain violet light.

537.311.33: 546.289 **1564**

Noise Measurements on Germanium Single Crystals in the Range of Impact Ionization between 5° and 10°K.—G. Lautz & M. Pilkuhn. (*Naturwissenschaften*, May 1960, Vol. 47, No. 9, p. 198.) Circuit noise and resistance as a function of field strength were measured on *p*- and *n*-type Ge. The characteristics obtained for *p*-type materials are discussed. See also 2790 of 1958 (Finke & Lautz).

537.311.33: 546.289 **1565**

Theory of Optical Radiation from Breakdown Avalanches in Germanium.—P. A. Wolff. (*J. Phys. Chem. Solids*, Nov. 1960, Vol. 16, Nos. 3/4, pp. 184–190.) A theory is given of the optical spectrum from avalanches, in terms of known properties of the band structure and breakdown process. Good agreement is obtained with experimental data.

537.311.33: 546.289 **1566**

Photon Emission from Avalanche Breakdown in Germanium *p-n* Junctions.—A. G. Chynoweth & H. K. Gummel. (*J. Phys. Chem. Solids*, Nov. 1960, Vol. 16, Nos. 3/4, pp. 191–197.) Results are given of an experimental study of the visible and near infrared emission spectrum from avalanching junctions. The emission mechanisms in different parts of the spectrum are discussed.

537.311.33: 546.289 **1567**

The Drift Mobility of Electrons and Holes in Germanium at Low Temperatures.—E. G. S. Paige. (*J. Phys. Chem. Solids*, Nov. 1960, Vol. 16, Nos. 3/4, pp. 207–219.) Measurements of drift mobility down to 20°K in samples of Ge containing impurity concentrations from 7×10^{12} to 4×10^{15} per cm³ are reported. Below 100°K, the observed minority carrier mobility is less than that expected from phonon and impurity scattering, probably owing to electron-hole scattering.

537.311.33: 546.289 **1568**

Recombination of Electrons and Donors in *n*-type Germanium.—G. Ascarelli & S. C. Brown. (*Phys. Rev.*, 1st Dec. 1960, Vol. 120, No. 5, pp. 1615–1626.) The rate of recombination of excess electrons, produced by breakdown at liquid He temperatures, is measured in As-doped Ge, as a function of temperature. α is found to vary as T^{-2}. Recombination light is detected. The recombination cross-sections found vary from 10^{-12} to 10^{-11} cm².

537.311.33: 546.289 **1569**

Germanium Saturated with Gallium Antimonide.—J. O. McCaldin & D. B. Wittry. (*J. appl. Phys.*, Jan. 1961, Vol. 32, No. 1, pp. 65–69.) The solubility of Sb is greatly enhanced by the presence of Ga but the converse is not true.

537.311.33: 546.289 **1570**

Solubility of Oxygen in Germanium.—W. Kaiser & C. D. Thurmond. (*J. appl. Phys.*, Jan. 1961, Vol. 32, No. 1, pp. 115–118.) The solubility as a function of temperature was determined and the precipitation of second-phase GeO_2 observed. The maximum solubility is 2×10^{18} atoms/cm³ and crystals containing 10^{17} atoms/cm³ have been prepared.

537.311.33: 546.289: 538.632 **1571**

Anisotropic Hall Coefficients in *n*-Type Germanium.—H. Miyazawa & H. Maeda. (*J. phys. Soc. Japan*, Nov. 1960, Vol. 15, No. 11, pp. 1924–1939.) Values of μ_H/μ are deduced from Hall-effect measurements at 77°K, 90°K, 195°K and 298°K on oriented single crystals of *n*-type Ge. The results are discussed with reference to theoretical scattering formulae.

537.311.33: 546.623'18 **1572**

AlP: Preparation, Electrical and Optical Properties.—H. G. Grimmeiss, W. Kischio & A. Rabenau. (*J. Phys. Chem. Solids*, Nov. 1960, Vol. 16, Nos. 3/4, pp. 302–309. In German.)

537.311.33: 546.681'19 **1573**

Band Structure and Electron Transport of GaAs.—H. Ehrenreich. (*Phys. Rev.*, 15th Dec. 1960, Vol. 120, No. 6, pp. 1951–1963.) Existing experimental data are reviewed and analysed.

537.311.33: 546.681'19 **1574**

Distribution Coefficient of Zinc in Gallium Arsenide.—A. Shibata. (*J. phys. Soc. Japan*, Nov. 1960, Vol. 15, No. 11, p. 2107.)

537.311.33: 546.682'86 **1575**

Quadratic Deviations from Ohm's Law in *n*-Type InSb.—R. J. Sladek. (*Phys. Rev.*, 1st Dec. 1960, Vol. 120, No. 5, pp.

1489–1509.) Measurements of resistivity of samples with various carrier concentrations are described. Electron mobility $\mu = \mu_0 (1 + \beta F^2)$, where F = electric field, and values of β give information on electron scattering processes.

537.311.33 : 546.823-31 **1576**

Some Properties of Titanium Sesquioxides containing Vanadium Ions.—T. Kawakubo, T. Yanagi & S. Nomura. (*J. phys. Soc. Japan*, Nov. 1960, Vol. 15, No. 11, p. 2102.)

537.312.62 : 538.632 **1577**

R.F. Hall Effect in a Superconductor.—G. Dresselhaus & M. S. Dresselhaus. (*Phys. Rev.*, 15th Dec. 1960, Vol. 120, No. 6, pp. 1971–1977.) The r.f. Hall field is calculated for the case of an applied d.c. magnetic field and r.f. electric field both parallel to the metal surface.

537.312.62 : 539.23 **1578**

Effect of Residual Gases on Superconducting Characteristics of Tin Films.—H. L. Caswell. (*J. appl. Phys.*, Jan. 1961, Vol. 32, No. 1, pp. 105–114.)

537.323 : 546.571'241 **1579**

Thermoelectric Properties of Ag_2Te.—P. F. Taylor & C. Wood. (*J. appl. Phys.*, Jan. 1961, Vol. 32, No. 1, pp. 1–3.) Measurements of Seebeck coefficient, electrical conductivity and thermal conductivity, made at room temperatures, indicate that Ag_2Te is inferior to Bi_2Te_3 for cooling applications in the temperature range considered.

538.221 **1580**

Magnetization Processes in Ferromagnetics.—L. V. Kirenskiĭ, M. K. Savchenko & I. F. Degtyarev. (*Zh. eksp. teor. Fiz.*, Sept. 1959, Vol. 37, No. 3 (9), pp. 616–619.) Powder-pattern and Kerr-effect observations on Si-Fe crystals containing 3% Si, indicate that a process of domain structure rearrangement play an important part in magnetization.

538.221 : 538.541 **1581**

Eddy-Current and Spin-Relaxation Losses in Thin Metal Tapes at Frequencies up to about 1 Mc/s.—R. Boll. (*Z. angew. Phys.*, May 1960, Vol. 12, No. 5, pp. 212–223.) Loss measurements were carried out on Ni-Fe and permalloy tapes of thickness 2·3–30 μ. Results obtained are discussed with reference to those given by other authors for these materials and for ferrites, and are related to the findings of classical eddy-current theory. Anomalies are partly due to spin relaxation effects; a method is given for separating the eddy-current and spin-relaxation contributions to the total losses. 58 references.

538.221 : 538.652 **1582**

Magnetostriction and Crystal Anisotropy of Nickel-Chromium and Nickel-Vanadium Alloys.—T. Wakiyama & S. Chikazumi. (*J. phys. Soc. Japan*, Nov. 1960, Vol. 15, No. 11, pp. 1975–1981.)

538.221 : 621.318.134 **1583**

Nonresonance Absorption of Oscillating Magnetic Field Energy by a Ferromagnetic Dielectric.—M. I. Kaganov & V. M. Tsukernik. (*Zh. eksp. teor. Fiz.*, Sept. 1959, Vol. 37, No. 3 (9), pp. 823–832.) The imaginary part of the longitudinal magnetic susceptibility is calculated using spin-wave theory.

538.221 : 621.318.134 **1584**

Magnetic After-Effect due to Electron Diffusion in Mg-Mn Ferrites.—S. Krupička. (*Naturwissenschaften*, April 1960, Vol. 47, No. 7, pp. 153–154.) Results of investigations on ferrites of the series $Mg_xMn_{1\cdot15-x}Fe_{1\cdot85}O_4$ are briefly reported.

538.221 : 621.318.134 **1585**

Resistance Changes of Ferrites in a Magnetic Field.—H. Schröder. (*Naturwissenschaften*, April 1960, Vol. 47, No. 8, pp. 175–176.) The magnetoresistance effect was measured on *n*-type polycrystalline $NiO.Fe_2O_3$; curves of magnetization and magnetostriction as a function of field strength are also given.

538.221 : 621.318.134 **1586**

Apparent Permeability and Intrinsic Permeability at Centimetre Wavelengths.—R. Vautier & A. J. Berteaud. (*C. R. Acad. Sci. Paris*, 4th April 1960, Vol. 250, No. 14, pp. 2527–2529.) Critical comment on the results of Spencer et al. (see 203 of 1957). Measurements made on two polycrystalline yttrium garnet specimens show that the intrinsic permeability, as usually calculated, is not solely dependent on the characteristics of the material.

538.221 : 621.318.134 **1587**

On the Ferrimagnetic Resonance of Europium Iron Garnet.—W. P. Wolf. (*J. phys. Soc. Japan*, Nov. 1960, Vol. 15, No. 11, p. 2104.) A semi-quantitative theory to account for the observed *g*-value of Eu-Fe garnet and its variation with temperature.

538.221 : 621.318.134 **1588**

Spin-Wave Spectrum of Yttrium Iron Garnet.—R. L. Douglass. (*Phys. Rev.*, 1st Dec. 1960, Vol. 120, No. 5, pp. 1612–1614.)

538.221 : 621.318.134 **1589**

A Further Explanation of the Shape of the Hysteresis Loop of 'Square Loop' Ferrites.—J. E. Knowles. (*Proc. phys. Soc.*, 1st Feb. 1961, Vol. 77, No. 494, pp. 225–229.) Theoretical hysteresis loops are calculated, given the stress distribution in the materials. See 273 of January.

538.221 : 621.395.625.3 **1590**

Particle Interaction in Magnetic Recording Tapes.—J. G. Woodward & E. Della Torre. (*J. appl. Phys.*, Jan. 1961, Vol. 32, No. 1, pp. 126–127.) Some improvements have been made to the methods described in 1723 of 1960 but the general conclusions are unchanged.

538.222 **1591**

Polarization Effects in Electrical 'Conductivity' of Artificial Sapphire at High Temperatures.—J. Cohen. (*J. Phys. Chem. Solids*, Nov. 1960, Vol. 16, Nos. 3/4, pp. 285–290.)

538.222 : 537.311.31 **1592**

Theory of Resistance Minimum in Dilute Paramagnetic Alloys.—K. Tani. (*J. phys. Soc. Japan*, Nov. 1960, Vol. 15, No. 11, pp. 1960–1962.) An investigation of the possibility that the resistance minimum arises from the short-range order of the spins of the solute atoms. See also 257 of 1960 (Brailsford & Overhauser).

538.222 : 538.569.4 **1593**

Electron Paramagnetic Resonance of Manganese in TiO_2.—H. G. Andresen. (*Phys. Rev.*, 1st Dec. 1960, Vol. 120, No. 5, pp. 1606–1611.)

538.222 : 538.569.4 **1594**

Spin-Lattice Relaxation Times in Sapphire and Chromium-Doped Rutile at 34·6 Gc/s.—J. H. Pace, D. F. Sampson & J. S. Thorp. (*Proc. phys. Soc.*, 1st Feb. 1961, Vol. 77, No. 494, pp. 257–260.) Measurements were made in the range 1·4–56°K and relaxation times up to 5 ms were found at the lowest temperatures. Both materials are promising for use in masers at mm λ.

539.23 : 537.533.7 **1595**

The Energy Distribution of Moderately Fast Electrons during Penetration through Thin Films.—G. Syrbe. (*Z. Phys.*, 15th June 1960, Vol. 159, No. 2, pp. 237–242.) A partial differential equation for the energy distribution is derived and the relation between electron energy and penetration range is calculated. Results of measurements on Al and Al_2O_3 films [see e.g. 206 of 1957(Young)] are compared with those calculated.

MATHEMATICS

517.431 : 513.813 **1596**

The Range of Validity of the Equation curl curl v = grad div $v - \Delta v$.—F. Müller. (*Hochfrequenztech. u. Elektroakust.*, April 1960, Vol. 69, No. 2, pp. 62–67.) Proof of the general applicability of the equation on the basis of Riemann geometry.

517.433 : 621.391 **1597**

Development Trends of Modern Operational Calculus.—F. H. Lange. (*Hochfrequenztech. u. Elektroakust.*, April 1960, Vol. 69, No. 2, pp. 67–75.) The application in information theory of four analytical methods based on integrals of the Laplace, Carson-Laplace, Duhamel and folding type is considered. The methods are compared and their relative value is assessed.

517.751.2 **1598**

Prolate Spheroidal Wave Functions, Fourier Analysis and Uncertainty: Part 1.—D. Slepian & H. O. Pollak. (*Bell Syst. tech. J.*, Jan. 1961, Vol. 40, No. 1, pp. 43–63.) "A complete set of bandlimited functions is described which possesses the curious property of being orthogonal over a given finite interval as well as over $(-\infty, \infty)$. Properties of the functions are derived and several applications to the representation of signals are made."

517.751.2 **1599**

Prolate Spheroidal Wave Functions, Fourier Analysis and Uncertainty: Part 2.—H. J. Landau & H. O. Pollak. (*Bell Syst. tech. J.*, Jan. 1961, Vol. 40, No. 1, pp. 65–84.) Application of the theory developed in 1598 above to time-limited and band-limited signals. In particular, if a finite-energy signal is given, the possible proportions of its energy in a finite time interval and a finite frequency band are found, as well as the signals which do the best job of simultaneous time and frequency concentration.

MEASUREMENTS AND TEST GEAR

621.3.018.41(083.74) **1600**

Changes in WWV/WWVH Standard Broadcasts.—(*Tech. News Bull. nat. Bur. Stand.*, Jan. 1961, Vol. 45, No. 1, pp. 11–13.) Details are given of a 36-bit, 100-pulse/sec time code which has been permanently incorporated in the transmissions from stations WWV and WWVH. See 3978 of 1960.

621.3.018.41(083.74):621.396 **1601**

A Very-Low-Frequency (V.L.F.) Synchronizing System.—C. H. Looney, Jr. (*Proc. Inst. Radio Engrs*, Feb. 1961, Vol. 49, No. 2, pp. 448–452.) A receiving system is described by which standard-frequency v.l.f. transmissions are used to control the phase of a local standard. Frequency synchronization better than 1 part in 10^{10} is possible, and when this is achieved a timing accuracy within 10 μs is obtained.

621.317.2:538.566.08]+534.844.1 **1602**

A New Reverberation Chamber for Sound and Electromagnetic Waves.—Meyer, Kurtze, Kuttruff & Tamm. (See 1393.)

621.317.2:621.317.321 **1603**

Microvolt Calibration Console.—(*Instrum. Practice*, Feb. 1961, Vol. 15, No. 2, pp. 197–198.) The console described has been developed by N.B.S. at Boulder, Colorado. It covers the range 1–10^5 μV at ten frequencies between 30 kc/s and 400 Mc/s. Accuracy is within 2–5% according to frequency. See also 1302 of 1959.

621.317.311:621.383 **1604**

The Measurement of Short-Circuit Currents particularly with Photocells.—W. Gründler. (*Arch. tech. Messen*, March 1960, No. 290, pp. 57–60.) Potentiometer circuits particularly for use in light measurements are described.

621.317.332.1.029.4 **1605**

Measurement of Impedance at Audio Frequency.—N. P. Scholes & J. E. Macfarlane. (*Electronic Technol.*, March 1961, Vol. 38, No. 3, pp. 106–107.) A simple apparatus is described for measuring modulus and phase angle using standard components only.

621.317.361 **1606**

Determination of Frequency Fluctuations with an Uncertainty of 10^{-9} to 10^{-10} by the Digital Measurement of the Period of One Beat.—R. Mitterer. (*Frequenz*, May 1960, Vol. 14, No. 5, pp. 157–162.) Methods for measuring short-term frequency fluctuations of crystal oscillators are compared. A method of using an accurate digital timing device for measuring the slow beat between two frequencies is described and an example is given of the comparison of the frequencies of two 1-Mc/s oscillators, to an accuracy within 1 part in 10^{11} for a measurement duration of 1 s.

621.317.382:538.632 **1607**

Automatic Electronic Converters for Measurements of R.M.S. Values and Active Power using Hall Generators.—G. Rehm. (*Arch. tech. Messen*, March 1960, No. 290, pp. 61–64.) Examples are given of circuits, for application in telemetry and process control systems, in which Hall generators are used to relate an alternating current to a direct current of equal effective value, or to convert a.c. active power to obtain proportional direct output.

621.317.44 **1608**

Field Measurements by the Method of Harmonics: Filter- and Difference-Type Probes.—J. Greiner. (*Nachr Tech.*, April 1960, Vol. 10, No. 4, pp. 156–162.) Experimental investigation and comparison of the characteristics of two of the categories of magnetometer tabulated in 1271 of April.

621.317.6:621.382.23 **1609**

Measurement of Varactor Quality.—N. Houlding. (*Microwave J.*, Jan. 1960, Vol. 3, No. 1, pp. 40–45.) A varactor is rated in terms of its reactance/resistance ratio at high microwave frequencies. Methods of measurement and experimental techniques are discussed, in particular slotted-line and reflectometer arrangements for 10 Gc/s. Suitable forms of test holder are shown.

621.317.7:621.397.132 **1610**

Fundamentals of Electronic Measurement Techniques for Colour Television.—Neidhardt. (See 1650.)

621.317.74:621.372.852.2 **1611**

Elimination of Mismatch Error by Means of a Phase-Shifter.—M. E. Gertsenshtein & L. N. Bryanskil. (*Izmer. Tekh.*, Jan. 1960, No. 1, pp. 48–51.) Description of a method for reducing errors in waveguide measurements of standing-wave ratio without the necessity of matching the generator and the receiving device at each frequency. The method can be applied to systems which cannot be matched. See also *Radiotekhnika i Elektronika*, May 1958, Vol. 3, No. 5, pp. 710–721.

621.317.755.001.4 **1612**

Measurement of the Nonlinearity of Deflection Factor of Oscillograph Tubes.—K. P. Beisse. (*Elektronik*, May 1960, Vol. 9, No. 5, pp. 129–131.) Photocell equipment for the direct measurement of deviations from linearity of c.r.-tube spot deflection is described.

621.317.784:538.639:537.311.33 **1613**

Multiphase Wattmeters based on the Magnetoresistance Effect of Semiconductors.—M. J. O. Strutt & S. F. Sun. (*Bull. schweiz. elektrotech. Ver.*, 9th May 1959, Vol. 50, No. 10, pp. 452–458.) Single-phase and three-phase wattmeter and varmeter circuits using disk-shaped magnetoresistance elements are given. The compensation of temperature effects is investigated for InSb and InAs elements. The Gauss-effect wattmeters are suitable for operation at frequencies up to 10 Mc/s; it may be possible to raise this limit to about 300 Mc/s.

OTHER APPLICATIONS OF RADIO AND ELECTRONICS

621.385.833 **1614**

The Effect of a Periodic Illumination of an Object on the Electron-Optical Image.—E. Gütter & H. Mahl. (*Optik, Stuttgart*, May 1960, Vol. 17, No. 5, pp. 233–243.) The blurring of the image in electron microscopes resulting from a.c. heating of the cathode was found to be due to thermal fluctuations in the specimen grid. The frequency dependence of this blurring effect was investigated experimentally and a theoretical treatment of the effect is given.

621.398 **1615**

A New Principle for Contactless Signalling.—W. Engel, F. Kuhrt & H. J. Lippmann. (*Elektrotech. Z., Edn A*, 25th April 1960, Vol. 81, No. 9, pp. 323–327.) Signalling devices incorporating Hall generators and transistor amplifiers are described; they find application in process control and automation systems.

621.398 **1616**

455-Mc/s Telemetry Ground Equipment.—F. F. Thomas. (*J. Brit. Instn Radio Engrs*, Jan. 1961, Vol. 21, No. 1, pp. 69–77.) The principles common to current types of receiving and recording equipment are discussed and a description is given of a test set suitable for calibrating telemetry senders.

621.398 **1617**

Analogue Telemetry Equipment and Systems: Part 2.—S. Poole, A. Potton & C. O. Titley. (*Electronic Engng*, Feb. 1961, Vol. 33, No. 396, pp. 77–83.) Telemetry systems used for research into 'flutter' and similar phenomena associated with flight at transonic and supersonic speeds are described. Part 1: 1284 of April (Young).

621.398:621.396.934 **1618**

Engineering Aspects of Missile Telemetry Equipment—the Airborne Sender for 24-Channel Telemetry.—W. M. Rae. (*J. Brit. Instn Radio Engrs*, Jan. 1961, Vol. 21, No. 1, pp. 57–67.) A brief description is given of a 24-channel a.m./f.m. system; design and production problems are discussed in detail.

621.391.812.6: 537.56 **1619**

Reflection and Transmission of Electromagnetic Waves at Electron Density Gradients.—F. A. Albini & R. G. Jahn. (*J. appl. Phys.*, Jan. 1961, Vol. 32, No. 1, pp. 75–82.) Solutions are obtained for the propagation of plane e.m. waves parallel to a gradient of free electron density. Reflection and transmission coefficients are derived for transition zones between a dielectric and a uniformly ionized gas and they are found to depend strongly on the width of the zone and less strongly on the detailed profile of the transition.

621.391.812.623 **1620**

A Note on Diffraction Round a Sphere or Cylinder.—G. Millington. (*Marconi Rev.*, 4th Quarter 1960, Vol. 23, No. 139, pp. 179–182.) A simple treatment is given of diffraction of radio waves round a sphere or cylinder, based on the known solution for propagation over a smooth earth.

621.391.812.63 + [537.56: 538.566 **1621**

Nonlinear Phenomena in a Plasma Located in an Alternating Electromagnetic Field.—Ginzburg & Gurevich. (See 1464.)

621.391.812.63 **1622**

The Scattering of Radio Waves by an Extended Randomly Refracting Medium.—S. A. Bowhill. (*J. atmos. terr. Phys.*, Feb. 1961, Vol. 20, No. 1, pp. 9–18.) The form of the emergent angular power spectrum is derived for the case of an e.m. wave incident upon a continuous medium containing three-dimensional inhomogenecities of refractive index. The medium cannot be analysed as a series of thin phase screens with independent phase profiles, owing to diffractive changes in the wave in passing from one inhomogeneity to the next.

621.391.812.63 **1623**

Analytical Considerations of Ionospheric Windows for Low-Frequency Radio Waves.—J. Heading. (*J. atmos. terr. Phys.*, Feb. 1961, Vol. 20, No. 1, pp. 31–39.) Reflection coefficients for ionospheres with free space below and above are examined for zeros. The vertical propagation case is considered for isotropic ionospheres and for anisotropic ionospheres with vertical magnetic field. An Epstein distribution of electrons is shown to give windows for one particular polarized wave. A numerical example is given.

621.391.812.63: 551.507.362.2 **1624**

The Application of Ray Tracing Methods to Radio Signals from Satellites.—I. N. Capon. (*Proc. phys. Soc.*, 1st Feb. 1961, Vol. 77, No. 494, pp. 337–345.) The effect which an ionosphere of given form will have on radio waves from an earth satellite is calculated with very high accuracy. Some results are given which apply to the Doppler shift, Faraday effect, and refraction of the received signal.

621.376.23: 621.391.822 **1625**

The Amplitude Distribution and False Alarm Rate of Noise after Post-Detection Filtering.—S. Thaler & S. A. Meltzer. (*Proc. Inst. Radio Engrs*, Feb. 1961, Vol. 49, No. 2, pp. 479–485.) A digital computer is used to simulate the passage of white Gaussian noise through a narrow-band filter, and the amplitude distribution is examined for several different detectors followed by a post detection filter.

621.391.812.63.029.62 **1626**

Reception of B.B.C. Television Sound Transmissions on 41·5 Mc/s at Halley Bay, Antarctica.—L. W. Barclay. (*J. Brit. Instn Radio Engrs*, Jan. 1961, Vol. 21, No. 1, pp. 89–92.) Signals were observed on 130 days between April and October 1958, a large number of the interceptions being due to normal F-layer propagation. Disturbance of the layer is correlated with absence of signals.

621.391.823: 621.396.669 **1627**

Radio-Interference Suppression of the Ignition Systems of Motor Vehicles.—W. Walter. (*Tech. Mitt. PTT*, 1st May 1960, Vol. 38, No. 5, pp. 153–164. In German and French.) Sources of interference and means of suppression are briefly noted and the methods of interference suppression adopted in Swiss Post Office vehicles are described, with details of measuring equipment and test results.

621.396.621.53: 621.391.822 **1628**

The Effect of Mixing Two Noisy Signals.—N. A. Huttly. (*Marconi Rev.*, 4th Quarter 1960, Vol. 23, No. 139, pp. 153–169.) An expression for the signal noise ratio in the beat note from two noisy signals being mixed, is obtained by a general analytical method. This is applied to practical examples with suitable assumptions.

621.396.621.54: 621.382.3 **1629**

Parasitic Oscillations in I.F. Stages and Frequency Changers of A.M. Receivers.—H. H. van Abbe, P. Bikker, A. Cense, A. N. van Dijkum & J. Rongen. (*Electronic Applic.*, June 1960, Vol. 20, No. 2, pp. 41–55.) The cause of oscillations in transistor circuits is briefly discussed and experiments to investigate the influence of circuit parameters on instability are described. Conditions which can render the stages completely stable without appreciable loss of gain are indicated.

621.396.666: 621.376.23 **1630**

Modifications to Directivity due to the Limiting of Signals.—B. Picinbono. (*C. R. Acad. Sci., Paris*, 21st March 1960, Vol. 250, No. 12, pp. 2179–2181.) Changes in directivity of a receiving system using a correlation technique are studied in relation to limiting of the signal. General formulae are established and applied to a particular example.

621.391: 621.38 **1631**

The Role of Electronics in Information Processing.—P. Neidhardt. (*Nachr.-Tech.*, May 1960, Vol. 10, No. 5, pp. 191–195.) The relation of basic logic switching circuits to the concepts of information theory is discussed.

621.396.2: 621.396.712.3: 621.397 **1632**

Wireless Studio Control Equipment.—A. Rettig, J. Baludis & H. Vorrath. (*Rundfunktech. Mitt.*, June 1960, Vol. 4, No. 3, pp. 102–112.) Equipment is described which provides a one-way speech channel between control cubicles and program and technical staff in television studios. Details are given of (*a*) an a.m. system operating at about 60 Mc/s, and (*b*) a f.m. system using frequencies in the range 20–70 kc/s.

621.396.43: 551.507.362.2 **1633**

Active Satellites.—L. Pollack. (*Wireless World*, Feb. 1961, Vol. 67, No. 2, pp. 52–56.) A description of a radio communication system using earth satellites as relays with particular reference to the Courier project.

621.396.43: 629.19 **1634**

Orbital Scatter.—(*Electronic Ind.*, Oct. 1960, Vol. 19, No. 10, p. 84.) Brief report of a proposed world-wide communication system using the reflecting properties of a continuous belt of metallic fibres formed at a height of several thousands of miles above the earth's surface.

621.396.65: 621.396.43 **1635**

Beyond-Horizon Radio Link.—K. Hoffman. (*Elektrotech. Z., Edn B*, 27th June 1960, Vol. 12, No. 13, pp. 320–324.) The installation described uses standard radio-link equipment modified for operation over a distance of about 200 km at 2 Gc/s to link West Berlin to the telephone system of the German Federal Republic. Transmitter power and receiver sensitivity have been raised, the aerial diameters increased from 3 to 10 m and a system of space-diversity reception has been adopted.

621.396.7.004.6: 519.24 **1636**

A Statistical Method for Predicting the Lifetime of Communication Installations.—H. Störmer. (*Arch. elekt. Übertragung*, May 1960, Vol. 14, No. 5, pp. 217–224.) Predictions of the expected useful life of an installation can be made if the average life of its components, though not accurately known, has been determined by sampling.

621.396.712 **1637**

Planning the New Motala Long-Wave Broadcasting Station.—E. Magnusson & F. Strandén. (*E.B.U. Rev.*, June 1960, No. 61A, pp. 107–113.) The new 2 × 300-kW transmitter, due to come into operation during 1961, has been designed to overcome the fading and interference problems affecting the existing station. A special circular array of aerials will be used on a new and larger site. For German version see *Rundfunktech. Mitt.*, June 1960, Vol. 4, No. 3, pp. 94–101.

621.396.712.029.62 **1638**

Selecting Frequencies for V.H.F. Sound Broadcasting Stations.—S. Lacharnay. (*E.B.U. Rev.*, June 1960, No. 61A, pp. 114–116.) The problem of frequency selection is considered for the case of three transmitters radiating different programs and feeding a common aerial through a multiplexer. A diagram is given showing unsuitable frequency spacings for the band 87·5–100 Mc/s.

SUBSIDIARY APPARATUS

621.3.087.4 : 621.395.625.3 : 537.533 **1639**

Experiments on Magnetic Tape Read-Out with an Electron Beam.—M. M. Freundlich, S. J. Begun, D. I. Breitzer, J. B. Gehman & J. K. Lewis. (*Proc. Inst. Radio Engrs*, Feb. 1961, Vol. 49, No. 2, pp. 498–509.) The feasibility of the method is demonstrated experimentally. Theoretically, a video signal with a bandwidth of 3 Mc/s could be reproduced with a signal/electron-shot-noise ratio of 30 dB from a recorded area density of 0·85 cycles/mil².

621.3.087.4 : 621.398 : 551.507.362.2 **1640**

Telemetry Signals from Sputnik III.—Henderson. (See 1506.)

621.311.62 : 621.316.72 **1641**

Precision Variable-Frequency Power Supply.—E. A. Gilbert. (*Electronics*, 13th Jan. 1961, Vol. 34, No. 2, pp. 99–100.) A ballast tube in a thermal regulating bridge controls the amplitude of the output and an adjustable filter controls the frequency from 50 c/s to 2 kc/s.

621.311.69 **1642**

Unconventional Methods of Generating Electrical Power.—B. A. Eagle. (*Trans. S. Afr. Inst. elect. Engrs*, Nov. 1960, Vol. 51, Part 11, pp. 233–253.) Discussion, pp. 253–256.) A review of methods for the direct generation of electricity from other forms of energy, including methods based on electrochemical and photoelectric conversion, solid-state devices, and high-velocity ionized gas. A comparative table of the principal devices is included. 32 references.

621.311.69 : 621.383.5 **1643**

Considerations on the Solar Cell.—D. A. Kleinman. (*Bell Syst. tech. J.*, Jan. 1961, Vol. 40, No. 1, pp. 85–115.) The absorption curve of the material and solar spectrum effects are contained in a single function readily obtained by numerical integration.

621.316.721.078.3 : 538.569.4 **1644**

Stabilization of a Magnetic Field by a Nuclear-Magnetic-Resonance Mass.—H. Hahn. (*C. R. Acad. Sci., Paris*, 28th March 1960, Vol. 250, No. 13, pp. 2355–2357.) The system briefly described will give an absolute long-term stability within ± 1 part in 10⁶.

621.316.722 : 621.382.3 : 621.316.93 **1645**

Overload Protection for Transistor Voltage Regulators.—A. G. Lloyd. (*Electronics*, 23rd Dec. 1960, Vol. 33, No. 52, pp. 56–59.) Various circuit modifications are described for protection against overload.

TELEVISION AND PHOTOTELEGRAPHY

621.397 : 621.391.826.2 **1646**

Two Methods for Determining the Signal and Noise Field Strengths of Television Reception in Regions with Multipath Reception.—H. Bödeker. (*Nachrichtentech. Z.*, May 1960, Vol. 13, No. 5, pp. 213–218.) The problem of field plotting in the presence of reflections is considered and a formula is derived for calculating the angle of incidence of the reflected ray and the ratio of its field strength to that of the direct ray. A method is given for the subjective assessment of picture quality in the field to evaluate signal strength and signal/noise ratio.

621.397.12 **1647**

S.C.F.M.—an Improved System for Slow-Scan Image Transmission.—C. Macdonald. (*QST*, Jan. & Feb. 1961, Vol. 45, Nos. 1 & 2, pp. 28–32 & 32–35.) Test results show that a system using subcarrier frequency modulation is superior to the original system using amplitude modulation (see 3266 of 1960). Details of modulator and demodulator circuits for the new system are given.

621.397.132 **1648**

Signal Noise Ratios in the N.T.S.C. Colour Television System.—N. Mayer. (*Rundfunktech. Mitt.*, June 1960, Vol. 4, No. 3, pp. 130–139.) The sensitivity of the N.T.S.C. system to interference by sinusoidal signals at various frequencies is determined on the basis of subjective tests.

621.397.132 **1649**

A New Survey of the B.B.C. Experimental Colour Transmissions.—J. B. Atkin, A. E. Stanley & S. N. Watson. (*B.B.C. Engng Div. Monograph*, Oct. 1960, No. 32, 31 pp.)

621.397.132 : 621.317.7 **1650**

Fundamentals of Electronic Measurement Techniques for Colour Television.—P. Neidhardt. (*Elektronische Rundschau*, May 1960, Vol. 14, No. 5, pp. 187–192.) Specialized electronic test equipment is described including colour-bar and pattern generators, vectorscope, and apparatus for phase measurement and for the statistical analysis of picture content.

621.397.132 : 621.372.55 **1651**

The Conversion of Nonlinear Distortion in Colour Television Transmission Systems.—L. Baumann. (*Bull. schweiz. elektrotech. Ver.*, 9th May 1959, Vol. 50, No. 10, pp. 450–466.) Mathematical treatment, on the basis of Volterra's line functions of distortion in nonlinear transmission networks as a function of input signal. The theoretical design of correction circuits is considered including that of an equalizer effective at one given frequency. See also 1652 below.

621.397.132 : 621.372.55 **1652**

Equipment for the Correction of Phase Difference.—T. Celio. (*Bull. schweiz. elektrotech. Ver.*, 9th May 1959, Vol. 50, No. 10, pp. 466–468.) An equalizer circuit is described for use in N.T.S.C. colour television systems conforming to C.C.I.R. standards. The system is based on a step-function approximation of the signal nonlinearity; phase difference is less than 5° within a 500 kc/s band around the colour subcarrier frequency, with amplitude correction to within 3%.

621.397.2 **1653**

A High-Resolution Television System.—L. L. Pourciau, M. Altman & C. A. Washburn. (*J. Soc. Mot. Pict. Telev. Engrs*, Feb. 1960, Vol. 69, No. 2, pp. 105–108.) The camera-tube used is a 1-in. vidicon. Its overall resolution is improved by increasing the focus field from the usual 40 G, and by a redesigned deflection system. A resolution better than 1 000 lines horizontally and 700 lines vertically is obtained. Frame rate is 30 c/s, field rate 60 c/s with a 2 : 1 interlace. Lines per frame can be varied from 675 to 1 035, and the system bandwidth is 20 Mc/s.

621.397.2 : 621.391.812.624 **1654**

Troposcatter Communications for Intercontinental TV Transmission.—E. Dyke. (*J. Soc. Mot. Pict. Telev. Engrs*, Feb. 1960, Vol. 69, No. 2, pp. 81–88.) Technical advances in the operation of tropospheric scatter systems for television are reviewed. Performance data relating to different methods of improving signal/noise ratio and examples of calculations for system design are given. 51 references.

621.397.2 : 621.395.625.3 **1655**

The Choice of the Carrier Frequency and Bandwidth of the F.M. Channel and the Circuit Arrangement of Magnetic Recording Equipment for Television Picture Signals.—M. Dibelius. (*Rundfunktech. Mitt.*, June 1960, Vol. 4, No. 3, pp. 119–129.) Better exploitation of tape and recording head properties may be achieved by transposing the carrier frequency of the f.m. band to a higher frequency, e.g. 50 Mc/s, before demodulation. Experimental recording modulator and demodulator circuits are described and results obtained are discussed.

621.397.232.4 **1656**

Convolution, on the Basis of System Theory, to the Problem of the Optimum Form of the Synchr Slope in Television.—K. Bernath. (*Tech. Mitt. PTT*, 1st April 1960, Vol. 38, No. 4, pp. 113–117. In German and French.) Theoretical examination and group-velocity characteristics are determined by Bode's method for idealized receiver i.f. filters used on six different television standards including the C.C.I.R.

standard with three different Nyquist slopes. The distortion effects in vestigial-sideband systems are briefly considered.

621.397.331.22 **1657**

An Improved Image Orthicon.—E. D. Hendry & W. E. Turk. (*J. Soc. Mot. Pict. Telev. Engrs*, Feb. 1960, Vol. 69, No. 2, pp. 88–91.) Limitations of the 3-in. image orthicon are mentioned. 4½-in. tubes have been produced with improvements in signal/noise ratio, centre and corner resolutions, and edge effect.

621.397.331.22: 621.397.61 **1658**

The Design of a 4½-Inch Image Orthicon Camera Channel.—G. E. Partington. (*J. Soc. Mot. Pict. Telev. Engrs*, Feb. 1960, Vol. 69, No. 2, pp. 92–98.) The improved characteristics of the 4½-in. tube and the higher order of optical, mechanical and circuit engineering required for the camera channel are discussed.

621.397.6.001.4 **1659**

Present and Future Test-Line Signals of the French Television Service.—A. Pouyferré & G. Frachet. (*E.B.U. Rev.*, June 1960, No. 61A, pp. 102–106.) The characteristic features of the vertical-interval test signals used on the French television network are described. For German version see *Rundfunktech. Mitt.*, Aug. 1960, Vol. 4, No. 4, pp. 153–157. See also 1411 of 1960 (Pröling).

621.397.61 **1660**

Tetrode Television Transmitters for Band IV/V.—U. Finkbein, J. Holle & S. Tobies. (*Elektronik. Z., Edn A*, 25th April 1960, Vol. 41, No. 9, pp. 332–338.) The requirements for transmitters operating in the frequency range 470–790 Mc/s are summarized. The construction and operation of a television transmitter which incorporates new types of u.h.f. triode are described. The rating of the basic transmitter unit is 2 kW for vision and 0·4 kW for sound; higher powers are obtained by combination with appropriate amplifier units.

621.397.61: 621.397.132 **1661**

Brief Presentation of the Additional Requirements for Monochrome Television Transmitters and for the Transmission of Colour Images.—G. Goldsmith. (*Nachrichtentech. Z.*, April 1960, Vol. 13, No. 4, pp. 175–178.) Details are given of proposed signal waveform specifications for the transmission, by monochrome transmitters, of N.T.S.C.-system colour television modified to C.C.I.R.-standards [see 4251 of 1959 (Davidse)].

621.397.621: 621.397.132 **1662**

Review of Studies Leading Undertaken for Television Systems with One or More Components.—G. Fischer. (*Radio Tech.*, April 1960, Vol. 10, No. 4, pp. 169–175.) Several scanning methods used in the production of television picture tubes are described and the problem of adhesion of luminescent materials is discussed.

TRANSMISSION

621.396.61(083.7) **1663**

I.R.E. Standards on Radio Transmitters: Definitions of Terms, 1961.—(*Proc. Inst. Radio Engrs*, Feb. 1961, Vol. 49, No. 2, pp. 486–487.) Standard 61 I.R.E. 15 S1.

621.396.712 **1664**

Bisamberg High-Power Transmitting Installation.—(*Elektrotech. u. Maschinenb.*, 1st May 1960, Vol. 77, Nos. 9/10, pp. 185–248.) A number of papers dealing with various aspects of planning, construction and operation of the high-power broadcast transmitters near Vienna, and including the following titles:—

(*a*) The Expansion of the Austrian Transmitter Network.—W. Füchsl (pp. 187–190).

(*b*) The Tasks of a Medium-Wave Broadcast Transmitting Installation in the Vicinity of the Austrian Federal Capital.—G. Caspar (pp. 190–195).

(*c*) The Medium-Wave Transmitting Installation Bisamberg in relation to the Planning of Transmitter Networks.—J. Burgstaller (pp. 195–200).

(*d*) The Transmitters of the Medium-Wave High-Power Broadcast Installation Bisamberg and their Power Supply.—H. Kikinger (pp. 200–211).

(*e*) The Electrical Equipment of the Bisamberg Aerial Installation.—R. Kayser (pp. 211–219).

(*f*) The Power Balance of the Bisamberg High-Power Transmitting Installation.—H. Kikinger (pp. 219–221).

(*g*) The Common-Frequency Control System of the Bisamberg High-Power Transmitting Installation.—G. Klement (pp. 221–224).

(*h*) The Transmitter Test and Monitoring Rack of the Bisamberg High-Power Transmitting Installation.—L. Jelinek (pp. 225–230).

(*i*) The Equipment for Automatic Transmitter Operation in the Bisamberg Installation.—B. Eiermann (pp. 230–233).

(*j*) The Building of the Bisamberg High-Power Transmitting Installation.—E. Vlahl-berg (pp. 234–236).

(*k*) The Aerial Masts of the New Bisamberg Medium-Wave Transmitting Installation.—E. Melzer (pp. 236–240).

(*l*) The Air-Heating, Ventilation and Air-Conditioning Plant of the Bisamberg High-Power Transmitter.—E. Heyna (pp. 245–248).

[illegible]

621.382.23 **1665**

Germanium Tunnel Diodes for the High-Frequency Region.—G. Kraul, V. Ottmann & H. V. Tronnier. (*Radio Mentsch. Z.*, April 1960, Vol. 13, No. 4, pp. 193–195.) The operating principle and construction are described; performance characteristics of a prototype are given.

621.382.23 **1666**

Evidence for States (Bands) in the Forbidden Gap of Degenerate GaAs and InP: Secondary Tunnel Currents and Negative Resistances.—N. Holonyak, Jr. (*J. appl. Phys.*, Jan. 1961, Vol. 32, No. 1, pp. 130–131.) The *I/V* characteristics are shown for two types of tunnel diode. The peculiarities of the characteristics are discussed and some tentative conclusions given.

621.382.23: 621.317.6 **1667**

Measurement of Varactor Quality.—Houlding. (See 1609.)

621.382.3.012 **1668**

Transistor Frequency Response.—J. R. James & D. J. Bradley. (*Electronic Technol.*, March 1961, Vol. 38, No. 3, pp. 80–82.) A graphical presentation of f_T as a function of the d.c. working point is described and the importance of f_T as a figure of merit is discussed.

621.382.3.012.8 **1669**

An Application of Matrix Methods to the Determination of the Equivalent Circuits of Earthed-Base and Earthed-Emitter Transistors at Low and High Frequencies.—R. Mezencev. (*C. R. Acad. Sci., Paris*, 28th March 1960, Vol. 250, No. 13, pp. 2338–2340.) Impedance matrices are developed and applied to T-type equivalent circuits, taking into account capacitance effects at high frequencies.

621.382.323 **1670**

The Alnetron.—A. V. J. Martin. (*Electronic Ind.*, Oct. 1960, Vol. 19, No. 10, pp. 98–100.) Description of an experimental four-terminal field-effect device having a transconductance of 6 mA/V and an output power of 6 W. Improved performance is considered possible if a semiconductor material such as GaAs is used.

621.382.333 **1671**

Transient Behaviour and Fundamental Transistor Parameters.—C. le Can. (*Electronic Applic.*, June 1960, Vol. 20, No. 2, pp. 56–83.) Detailed analysis of the transient behaviour of alloy junction transistors both when switching on and switching off.

621.382.333 **1672**

Symmetrical Transistors.—G. H. Parks. (*J. Brit. Instn Radio Engrs*, Jan. 1961, Vol. 21, No. 1, pp. 79–88.) Significant differences in performance compared with unsymmetrical alloy junction transistors are revealed by theoretical examination. Brief descriptions are given of circuits in which the symmetrical type offer improvements.

621.382.333 **1673**

Alloy-Diffused Transistors.—E. Wolfendale. (*Electronic Engng, Brit.*, 1961, Vol. 33, No. 396, pp. 88–93.) It is shown why conventional alloy junction transistors cannot be further exploited at u.h.f., and alloy-diffused transistors and their advantages are described. The performances of the two types are compared and the future of the new type is assessed.

621.382.333: 621.317.3 **1674**

Measuring Power Transistor Parameters by Pulse Techniques.—D. H. Breslow. (*Electronics*, 6th Jan. 1961, Vol. 34, No. 1, pp. 120–122.) The advantages of pulse methods of measurement are discussed and circuit details of test equipment are given.

621.382.333: 621.375.4.018.783 **1675**

Investigations of Distortion in Low-Frequency Junction Transistors.—H. Höncke. (*Nachr Tech.*, April–June 1960, Vol. 10, Nos. 4–6, pp. 163–166, 209–216 & 273–277.) Second- and third-order distortion coefficients are calculated for small-signal conditions at low frequencies in the three basic circuit configurations. The dependence of distortion on operating conditions is considered in detail.

621.382.333: 621.396.822 **1676**

Variation of L.F. Noise Figure of a Junction Transistor.—S. Deb & A. N. Daw. (*J. Brit. Instn Radio Engrs*, Jan. 1961, Vol. 21, No. 1, pp. 49–56.) Noise measurements have been made over a 300-c/s bandwidth centred on 1 kc/s at temperatures in the range −20 to +45°C and collector currents between 0·3 and 1·6 mA. The major part of the noise can be attributed to surface recombination.

621.383.5: 538.63 **1677**

Variation of Photovoltaic Response with Magnetic Field for a Germanium *p-n* Junction.—W. Dunstan. (*Proc. phys. Soc.*, 1st Feb. 1961, Vol. 77, No. 494, pp. 459–466.) Measurements are made of the variation with magnetic field of the open-circuit voltage from a Ge *p-n* junction photocell. The effect depends on field orientation and is proportional to illumination. Results are partially explained.

621.385.032.212.3 **1678**

Rise-Time Measurements in MgO Cold-Cathode Diodes.—A. Sussman. (*Proc. Inst. Radio Engrs*, Feb. 1961, Vol. 49, No. 2, pp. 517–518.) Current rise times on application of a step voltage have been measured as a function of the initial current and magnitude of the step itself.

621.385.032.266 **1679**

A Hollow-Beam Focusing System.—P. M. Lally. (*Proc. Inst. Radio Engrs*, Feb. 1961, Vol. 49, No. 2, pp. 514–515.) The system is based on solid-beam Brillouin focusing, the central core of a solid beam of electrons being replaced by a central cylindrical conductor.

621.385.1.029.6: 003.62 **1680**

Graphical Symbols for Microwave Valves.—G. W. Epprecht. (*Bull. schweiz. elektrotech. Ver.*, 7th May 1960, Vol. 51, No. 9, pp. 457–461.) An attempt is made to rationalize the system of microwave-valve symbols by creating a number of elementary symbols which are then combined to represent any particular electron-beam device. 69 symbols and symbol combinations are given.

621.385.2 **1681**

Theory of the Space-Charge-Limited Diode.—H. Pötzl & K. Richter. (*Arch. elektr. Übertragung*, May 1960, Vol. 14, No. 5, pp. 225–234.) A simplified theory of one-dimensional electron flow is derived, and, assuming the kinetic temperature of the electrons to be constant, the equations of the space-charge-limited diode are solved for the stationary and nonstationary case. The boundary conditions are determined, and the diode admittance is calculated and compared with experimental data.

621.385.3.029.64 **1682**

Small-Signal Performance and Noise Properties of Microwave Triodes.—M. T. Vlaardingerbroek. (*Philips Res. Rep.*, April 1960, Vol. 15, No. 2, pp. 124–221.) A report is given of theoretical and experimental studies of a triode at 4 Gc/s. An equivalent circuit is deduced to account for internal feedback, noise behaviour and electrons in the active space. Methods of measuring the four-pole coefficients and characteristic noise quantities are described. The results of measurements using these methods are compared with theory. 63 references.

621.385.6: 537.533 **1683**

An Experiment of Ion Relaxation Oscillation in Electron Beams.—Y. Koike & Y. Kumagai. (*Proc. Inst. Radio Engrs*, Feb. 1961, Vol. 49, No. 2, pp. 525–526.) Results obtained using a Hernquvist-type ion-trapping electron gun producing a strip beam are described.

621.385.63 **1684**

A Unified Theory of Electron-Beam Interaction with Slow-Wave Structures, with Application to Cut-Off Conditions.—R. M. Bevensee. (*J. Electronics Control*, Dec. 1960, Vol. 9, No. 6, pp. 401–437.) Small-signal transmission-line equations are obtained for a longitudinally confined beam, including relativistic effects, under the action of cavity solenoidal electric field and space-charge irrotational field.

621.385.63 **1685**

Interaction of Premodulated Electron Streams with Propagating Circuits.—J. E. Rowe & J. G. Meeker. (*J. Electronics Control*, Dec. 1960, Vol. 9, No. 6, pp. 439–466.) Linear and nonlinear analyses are presented for prebunched beams interacting with a travelling r.f. wave in both growing-wave and beating-wave devices.

621.385.63.032.269.1 **1686**

Space-Charge Effects in Ultra-Low-Noise Electron Guns.—J. Berghammer. (*RCA Rev.*, Sept. 1960, Vol. 21, No. 3, pp. 369–376.) The d.c. characteristics of a typical electron gun used in low-noise travelling-wave tubes are investigated. Variations in positive beam-forming potentials cause sudden jumps in the cathode current. This space-charge effect, rather than temperature limitation, is the main cause of current saturation.

621.385.63.032.269.1 **1687**

Design Considerations for Grid-Controlled Electron Guns for Pulsed Travelling-Wave Tubes.—H. J. Wolkstein. (*RCA Rev.*, Sept. 1960, Vol. 21, No. 3, pp. 389–413.) Methods are suggested for determining the parameters for an additional grid-type aperture, current transmission, and cut-off amplification factor. A discussion of the methods of grid positioning and associated design is given for the convergent-flow gun.

621.385.632 **1688**

Correlation between the Theory and Performance of a C-Band Travelling-Wave Tube.—T. S. Chen. (*J. Electronics Control*, Nov. 1960, Vol. 9, No. 5, pp. 323–346.) Performance was predicted on the basis of small-signal normal-mode theory and was found to be in good agreement with measured characteristics. Curves are given of the c.w. output power over the range 3 800–6 400 Mc/s and for 0·001, 0·01 and 0·1 duty cycles. Details are given of the gun and helix design and the measured voltage s.w.r. over the range.

621.385.632 **1689**

Slow-Wave Structures for Electrostatically Focused High-Power Travelling-Wave Tubes.—E. F. Belohoubek. (*RCA Rev.*, Sept. 1960, Vol. 21, No. 3, pp. 377–388.) Two structures are described. One is of the crossed-bar type in which the focusing electrodes are individually supported by chokes, and the other is a structure of the folded-line type with inserted focusing electrodes.

621.385.632 **1690**

Multiple-Transit Amplification by Travelling-Wave Tube.—D. A. James. (*Electronic Technol.*, March 1961, Vol. 38, No. 3, pp. 108–109.) A signal with 1-Mc/s bandwidth was passed twice through a travelling-wave tube Type CV 2188, firstly at 4 024 Mc/s, secondly at 4 096 Mc/s. The overall gain achieved was 10 dB, but 23 dB should be possible.

621.385.632: 621.372.2 **1691**

An Interaction Circuit for Travelling-Wave Tubes.—P. J. Crepeau & I. Itzkan. (*Proc. Inst. Radio Engrs*, Feb. 1961, Vol. 49, No. 2, p. 525.) Characteristics of a pair of coplanar meander lines are given.

621.385.64 **1692**

Energy Build-Up in Magnetrons.—D. Kobayashi. (*Rev. elect. Commun. Lab., Japan*, May/June 1960, Vol. 8, Nos. 5/6, pp. 266–269.) A previous theoretical analysis (719 of 1960) has been extended to energy build-up and is used to explain some characteristics of p.p.m. noise.

621.385.832.032.269.1 **1693**

Emission Decay below Narrow Grid Apertures.—A. Sandor. (*Le Vide*, Sept./Oct. 1960, Vol. 15, No. 89, pp. 373–380. In French and English.) A sharp increase in current-density occurs at the cathode centre as the grid aperture is reduced in size. This increase causes failure of the protective space charge and subsequent chemical poisoning of the cathode surface.

621.387.132.223: 621.396.96 **1694**

Gas Clipper Tubes for Radar Service.—W. W. Watrous & J. McArtney. (*Electronics*, 16th Dec. 1960, Vol. 33, No. 51, pp. 80–83.) Hydrogen-filled thyratrons prevent the building up of dangerous voltages in the pulse forming circuits.

Abstracts and References

COMPILED BY THE RADIO RESEARCH ORGANIZATION OF THE DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH AND PUBLISHED BY ARRANGEMENT WITH THAT DEPARTMENT

The abstracts are classified in accordance with the Universal Decimal Classification. They are arranged within broad subject sections in the order of the U.D.C. numbers, except that notices of book reviews are placed at the ends of the sections. U.D.C. numbers marked with a dagger (†) must be regarded as provisional. The abbreviations of journal titles conform generally with the style of the World List of Scientific Periodicals. An Author and Subject Index to the abstracts is published annually; it includes a list of journals abstracted, the abbreviations of their titles and their publishers' addresses. Copies of articles or journals referred to are not available from Electronic Technology. *Application must be made to the individual publishers concerned.*

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ACOUSTICS AND AUDIO FREQUENCIES

534.2 **1695**

The Effective Dynamic Parameters for Sound Propagation in Inhomogeneous Media.—I. A. Ratinskaya. (*Akust. Zh.*, 1960, Vol. 6, No. 1, pp. 128–131.) Revision of an earlier analysis [1041 of 1959 (Khaĭkovich & Khalfin)].

534.2-14 **1696**

Sound Field of a First-Order Normal-Mode Wave in a Layer of Water.—F. I. Kryazhev. (*Akust. Zh.*, 1960, Vol. 6, No. 1, pp. 65–76.)

534.2-14 **1697**

Normal-Mode Waves in a Three-Layer Medium.—F. I. Kryazhev & N. A. Petrov. (*Akust. Zh.*, 1960, Vol. 6, No. 2, pp. 229–236.) An analysis of experimental data on the propagation of sound waves in some shallow waters of the Caspian Sea in the frequency range 8–1 000 c/s. Waveguide-type propagation occurs at values of $kh > 2{\cdot}8$, where k is the wave number and h the layer depth.

534.2-14 **1698**

A Method of Wave Front Determination for a Sound Wave of Approximately Sawtooth Form.—L. K. Zarembo. (*Akust. Zh.*, 1960, Vol. 6, No. 1, pp. 43–46.) Analysis of the propagation of sawtooth waves in water.

534.2-14 **1699**

Investigation of Low-Frequency Sound Propagation in Shallow Waters.—V. S. Grigor'ev & F. I. Kryazhev. (*Akust. Zh.*, 1960, Vol. 6, No. 1, pp. 34–42.) Description of an experimental method illustrating the waveguide-type propagation of sound in sea water at frequencies up to 10 kc/s.

534.213.4 **1700**

Sound Propagation in a Waveguide with Rectangular Grooves in the Walls.—A. D. Lapin. (*Akust. Zh.*, 1960, Vol. 6, No. 2, pp. 237–243.) Mathematical treatment relating to acoustic filters. The optimum size of a transverse channel in a waveguide wall for greatest sound reflection is determined and the frequency characteristics of a waveguide are obtained.

534.213.4-14 **1701**

Signal Amplitude and Phase Fluctuations Induced by Surface Waves in Ducted Sound Propagation.—J. A. Scrimger. (*J. acoust. Soc. Amer.*, Feb. 1961, Vol. 33, No. 2, pp. 239–247.) The dependence of the amount of amplitude and phase fluctuation in received signals on surface wave crest-to-trough height has been determined for frequencies in the range 1–10 kc/s propagated over a distance of 300 ft in water 10 ft deep.

534.213.4-8 **1702**

Theory of Ultrasonic Attenuation in Cylindrical and Rectangular Waveguides.—E. F. Carome & J. M. Witting. (*J. acoust. Soc. Amer.*, Feb. 1961, Vol. 33, No. 2, pp. 187–197.) The systems studied consist of a piston source radiating into a bounded inviscid fluid and a receiver the same size as the source. Expressions for receiver output are derived, and acoustic loss as a function of path length is computed for various source and waveguide configurations.

534.22-8-14 **1703**

The Propagation Velocity of Ultrasonic Wave of Finite Amplitude in Liquids.—L. K. Zarembo & V. V. Shklovskaya-Kordi. (*Akust. Zh.*, 1960, Vol. 6, No. 1, pp. 47–51.) Application of a phase-comparison method for an investigation of velocity jump.

534.232 **1704**

Experimental Investigation of Cylindrical Focusing Systems.—I. N. Kanevskiĭ. (*Akust. Zh.*, 1960, Vol. 6, No. 1, pp. 123–124.) Results of measurements made on cylindrical $BaTiO_3$ focusing radiators in the frequency range 600–900 kc/s with angles of aperture 30°, 60° and 90° are noted.

534.26 **1705**

Diffraction of a Plane Sound Wave Incident at an Arbitrary Angle on an Infinite Cylindrical Cavity in an Elastic Medium.—V. V. Tyutekin. (*Akust. Zh.*, 1960, Vol. 6, No. 1, pp. 101–106.)

534.26-14 **1706**

Scattering of Acoustic Energy by Solid and Air-Filled Cylinders in Water.—G. R. Barnard & C. M. McKinney. (*J. acoust. Soc. Amer.*, Feb. 1961, Vol. 33, No. 2, pp. 226–238.) Results are given of an experimental investigation of the scattering of acoustic energy from solid and hollow cylinders as a function of cylinder length, pulse length and frequency.

534.286-8 **1707**

Contribution to the Theory of Ultrasonic Absorption in Metals.—V. P. Silin.

(*Zh. eksp. teor. Fiz.*, March 1960, Vol. 38, No. 3, pp. 977–983.) Theoretical treatment of low-temperature absorption at wavelengths small compared to the electron mean free path. In the region of wavelengths which are approximately equal to the thickness of the anomalous skin layer a decrease in the ratio of the absorption coefficient to frequency should be observed with increase of frequency.

534.41 : 538.652 **1708**

The Relation between the Magnetic Properties and Sensitivity of Magnetostrictive Receivers of Nickel-Zinc Ferrite.—A. D. Sokolov & Ya. S. Shur. (*Akust. Zh.*, 1960, Vol. 6, No. 1, pp. 131–133.) Experimental data are tabulated.

534.52 **1709**

Sound Field in the Focal Plane of Converging Spherical Beams.—B. D. Tartakovskiĭ. (*Akust. Zh.*, 1960, Vol. 6, No. 1, pp. 96–100.) The distribution of the oscillation velocity and sound pressure in the focal plane is calculated for a focusing system in which the beams have a non-uniform amplitude distribution over the wave front.

534.6 : 534.84 **1710**

Application of Frequency Modulation to Acoustic Measurements.—V. A. Zverev & A. I. Kalachev. (*Akust. Zh.*, 1960, Vol. 6, No. 2, pp. 205–212.) A c.w. f.m. technique is described for measurements in normal rooms. Spectrum and correlation analyses are applied for locating sources of sound and reflections. The autocorrelation process makes it possible to separate the discrete reflections from reverberation signals.

534.61-8 : 539.2 **1711**

Phonon-Photon Double-Quantum Transitions as a Detector of Microwave Ultrasonics.—N. S. Shiren. (*Phys. Rev. Lett.*, 15th Feb. 1961, Vol. 6, No. 4, pp. 168–170.) A fast intensity detector for microwave ultrasonic pulses is described. The spin systems of Ni^{2+} and Fe^{2+} in MgO crystals at 2 °K are used. The absorption of c.w. microwaves is increased when ultrasonic pulses are transmitted through the crystal. Absolute ultrasonic energy measurements are possible.

534.75 **1712**

Subdivision of the Audible Frequency Range into Critical Bands (Frequenzgruppen).—E. Zwicker. (*J. acoust. Soc. Amer.*, Feb. 1961, Vol. 33, No. 2, p. 248.) A note showing the relation between critical-band function and frequency, and defining the proposed frequency limits of the critical bands.

534.79 **1713**

The Loudness of Directional Sound Fields.—D. W. Robinson & L. S. Whittle. (*Acustica*, 1960, Vol. 10, No. 2, pp. 74–80.) Subjective measurements have been made in the frequency range 1·6–10 kc/s of the variation of loudness with source direction, together with corresponding measurements of sound pressure. The loudness estimated from the sound pressures at left and right ears agrees well with the observed binaural loudness if a 6-dB summation law is assumed.

534.844 **1714**

Recent Subjective Acoustic Investigations of Reverberation Time.—T. Tarnóczy, T. Járfás & M. Lukács. (*Elektronische Rundschau*, June 1960, Vol. 14, No. 6, pp. 223–226.) A definition of 'subjective reverberation time' is given which is based on a subjective assessment allowing for different musical tempi. Experimental results are discussed.

534.844.1 + [621.317.2 : 538.566.08 **1715**

The Upper Limits for the Reverberation Time of Reverberation Chambers for Acoustic and Electromagnetic Waves.—K. Walther. (*J. acoust. Soc. Amer.*, Feb. 1961, Vol. 33, No. 2, pp. 127–136.) The upper limits for the reverberation time and Q factor of acoustic reverberation chambers with perfectly rigid walls with a smooth surface are determined. The reflection factor for a rigid wall of arbitrary thermal conductivity is determined from a consideration of the viscosity and heat conductivity in the boundary layer. The cases of isothermal and adiabatic boundary conditions are discussed. See 1393 of May (Meyer et al.).

534.844.1 **1716**

Measurement of the Degree of Diffusion of a Sound Field in Rooms by means of a Directional Microphone.—V. V. Furduev & Chen Tun. (*Akust. Zh.*, 1960, Vol. 6, No. 1, pp. 107–115.) The method is based on a comparison of the directivity characteristics of a microphone in a 'dead' room and in the room to be investigated. The theory of measurement using a microphone which is a combination of a pressure type and pressure-gradient type is given. Some results obtained in a reverberation chamber and broadcasting studios are shown.

621.395.61 **1717**

A Microphone Arrangement of High Directivity.—P. Dämmig. (*Acustica*, 1960, Vol. 10, No. 2, pp. 120–123. *In* German.) A parallel arrangement of two groups of slit-tube directional microphones forming a crossed array is described. The half-width of the directional characteristic is 15° at 1 kc/s and 12° at 4 kc/s.

621.395.616 **1718**

Pressure Response of Condenser Microphones at Low Ambient Pressures.—J. D. Chalupnik, E. Rule & F. J. Sudbrink. (*J. acoust. Soc. Amer.*, Feb. 1961, Vol. 33, No. 2, pp. 177–178.) Pressure response curves at a number of ambient pressures in the range of 10^6 dyn/cm² — 1·7 × 10^5 dyn/cm² have been obtained for two commonly used condenser microphones. Features of the response curves are discussed from a qualitative point of view.

621.395.625.3 : 538.221 **1719**

The Properties of Modern Magnetic Recording Tapes.—P. H. Werner & E. Kohler. (*Tech. Mitt. PTT*, 1st July 1960, Vol. 38, No. 7, pp. 217–228. In French and German.) Mechanical and electrical properties are reviewed and means of reducing print-through effects are discussed.

AERIALS AND TRANSMISSION LINES

621.315.212 **1720**

Continuous Loading of Coaxial Circuits without Air Gap.—P. M. Prache. (*Câbles & Transm.*, July 1960, Vol. 14, No. 3, pp. 180–190.) Theoretical determination of the attenuation in a coaxial circuit loaded by toroidal ferrite cores inserted between the two conductors so that there is no air gap. Experimental results confirm the theoretical calculations and show that it is possible to reduce coaxial-circuit attenuation in this way, at least for frequencies up to 2 Mc/s.

621.372.2 : 621.372.44 **1721**

Periodic Solutions of the Wave Equation with a Nonlinear Interface Condition.—W. L. Miranker. (*IBM J. Res. Developm.*, Jan. 1961, Vol. 5, No. 1, pp. 2–24.) An analysis of the voltage oscillations in a transmission line when shunted with a diode represented by a nonlinear capacitance.

621.372.8 : 621.396.44 **1722**

Characteristics of Waveguides for Long-Distance Transmission.—A. E. Karbowiak & L. Solymar. (*J. Res. nat. Bur. Stand.*, Jan.–Feb. 1961, Vol. 65D, No. 1, pp. 75–88.) A detailed discussion and analysis of propagation characteristics including effects of bends and other discontinuities. 35 references.

621.372.81 **1723**

The Theory of Waveguides and Cavities: Part 2—Examples of Waveguides and Discussion of Special Points.—R. A. Waldron. (*Electronic Technol.*, April 1961, Vol. 38, No. 4, pp. 140–147.) The method described in Part 1 (1604 of May) is applied to two examples, (*a*) an air-filled circular waveguide; (*b*) a coaxial line in which the core material is considered as a dielectric.

621.372.826 **1724**

Sommerfeld and Harms-Goubau Waveguides in the Centimetre and Millimetre Wave Range.—H. Severin. (*Arch. elekt. Übertragung*, April 1960, Vol. 14, No. 4, pp. 155–162.) Calculation of transmission characteristics of surface waveguides for cm and mm λ. Curves are given of the radius of the external field and of attenuation as a function of frequency and line parameters. Given a maximum permissible attenuation of 3·5 dB/km Sommerfeld and Goubau lines are not suitable for wavelengths below 5 cm.

621.372.826 : 537.226 **1725**

Measurement of the Properties of Dielectric Transmission Lines at Millimetre Wavelengths in an Optically Coupled Resonator.—G. Schulten. (*Arch. elekt. Übertragung*, April 1960, Vol. 14, No. 4, pp. 163–166.) Measurements of dispersion and attenuation of the HE_{11} mode were made at 5 and 8 mm λ on threads of polythene of various diameters for use as dielectric lines of the ordinary or image type [*see e.g.* 2827 of 1959 (Schlesinger & King)].

621.372.831.2 **1726**

The Reflection of the Fundamental Mode at Waveguide Discontinuities, particularly with a Gradual Transition from a Rectangular to a Circular Waveguide.—K. Schnetzler. (*Arch. elekt. Übertragung*, April 1960, Vol. 14, No. 4, pp. 177–182.) Theoretical expressions are derived for the reflection of the fundamental mode at waveguide junctions involving smooth transitions with small angles. Calculated values for a rectangular/circular junction agree well with measured values.

621.372.837 **1727**

A Low-Loss, Semiconductor Microwave Switch.—D. L. Rebsch. (*Proc. Inst. Radio Engrs*, March 1961, Vol. 49, No. 3, pp. 644–645.) The superiority of a new semiconductor switch configuration is discussed in which the diode is mounted in the arm of symmetry of an *H*-plane T-junction.

621.372.853.1 **1728**

Backward Waves in Waveguide with Anisotropic Dielectric.—F. Borgnis. (*Bull. schweiz. elektrotech. Ver.*, 8th Oct. 1960, Vol. 51, No. 20, pp. 1030–1033.) The conditions under which separately excited backward waves can exist in a waveguide are investigated.

621.372.853.2 **1729**

Backward Waves in Longitudinally Magnetized Ferrite Rods.—A. W. Trivelpiece, A. Ignatius & P. C. Hedtcher. (*J. appl. Phys.*, Feb. 1961, Vol. 32, No. 2, pp. 259–267.) A quasi-static approximation ($\nabla \times \mathbf{H} = 0$ is used to develop a theory of this effect, the waves propagating with a phase velocity $<c$ and in a frequency range where the permeability is negative. Experimental measurements of phase velocity are described. Interaction with an electron beam is considered.

621.396.67:[24] **1730**

Useful Radiation from an Underground Antenna.—H. A. Wheeler. (*J. Res. nat. Bur. Stand.*, Jan./Feb. 1961, Vol. 65D, No. 1, pp. 89–91.) Radiation efficiency is derived simply for (*a*) a vertical loop in a submerged radome, and (*b*) a submerged horizontal insulated wire with each end connected to a ground electrode. A power efficiency of 0·0014 is given in a specific example of (*b*).

621.396.674.3 **1731**

The Characteristics of Dipole Impedances with Dipole Excitation Varying Exponentially with Time.—K. Fränz. (*Arch. elekt. Übertragung*, April 1960, Vol. 14, No. 4, pp. 167–168.) Mathematical treatment of dipole impedance by variational principles for real frequencies > 0.

621.396.677: 523.164 **1732**

An Interferometer for the Measurement of Radio-Source Sizes.—Goddard, Watkinson & Mills. (See 1017.)

621.396.677: 621.391.812.63 **1733**

Launching Over the Sea of Vertically Polarized Waves for Long-Distance Ionospheric Propagation.—E. O. Willoughby. (*Proc. Instn Radio Engrs, Aust.*, Sept. 1960, Vol. 21, No. 9, pp. 591–597.) Simple vertically polarized aerials with mast heights of 150 ft or less, launching over the sea, are shown to be capable of gains exceeding 14 dB over a frequency band of 5 to 15 Mc/s, with good matching and efficient radiation between 1° and 10° elevation.

621.396.677.3 **1734**

Linear Aerial Arrays with Attenuated Side Lobes.—K. Baur. (*Elektronische Rundschau*, June 1960, Vol. 14, No. 6, pp. 217–222.) The radiation diagrams of linear aerial arrays are discussed and a method is given for modifying side-lobe maxima, operating bandwidth and radiation angle by varying the aerial spacing. Examples of 4-, 8- and 16-aerial arrays with unequal aerial spacing are given.

621.396.677.3: 621.396.965 **1735**

A High-Resolution Rapid-Scan Antenna.—H. V. Cottony & A. C. Wilson. (*J. Res. nat. Bur. Stand.*, Jan./Feb. 1961, Vol. 65D, No. 1, pp. 101–110.) Describes an electronically scanned broadside receiving array of 7 Yagi elements with spacing 1·4 λ. A 5·8° beam swept over a 41·8° azimuth 20 times per second is produced, operating at 40–92 Mc/s. Sample records showing ionospheric scatter and reflections from meteor trails and sporadic-E are given.

621.396.677.83: 621.396.65 **1736**

The Deflector as Part of a Directional Aerial System.—H. D. Kühne. (*Telefunken Ztg*, June 1960, Vol. 33, No. 120, pp. 129–131. English summary, pp. 157–158.) The design of plane or parabolic reflectors used as deflectors in radio-link aerial systems is described [see 45 of January (Münzer)]. Experimental results obtained at 3·3 and 7·5 cm λ are compared with calculated data.

AUTOMATIC COMPUTERS

681.142: 530.221: 539.23 **1737**

Patterns of Thin Films make Fast Nondestructive Memories.—J. W. Hart. (*Electronics*, 17th Feb. 1961, Vol. 34, No. 7, pp. 126–128.) The Kerr magneto-optic method is used to show that irreversible domains can be formed in thin magnetic films.

681.142: 538.221: 539.23 **1738**

The Problem of 'Coupling' in a Switching Circuit System consisting of Thin Magnetic Films.—H. Oguey. (*Bull. schweiz. elektrotech. Ver.*, 8th Oct. 1960, Vol. 51, No. 20, pp. 1004–1010.) Problems relating to the design of logic switching circuits formed by magnetic film elements are reviewed.

CIRCUITS AND CIRCUIT ELEMENTS

621.316.86: 621.317.332 **1739**

The Impedance Value of Carbon Film Resistors as a Function of Frequency and D.C. Resistance.—A. Debel & L. Hechler. (*Frequenz*, June 1960, Vol. 14, No. 6, pp. 193–197.) An arrangement is described for impedance measurements in which the dimensions of the mounting are standardized in relation to resistor dimensions so that comparisons are possible between results obtained for resistors of different size. Curves are given of maximum usable frequency as a function of d.c. resistance, and of skin effect as a function of frequency and surface resistance.

621.318.57: 621.382.33: 517 **1740**

Methods of Analysis of Circuit Transient Performance.—L. Hellerman & E. J. Skiko. (*IBM J. Res. Developm.*, Jan. 1961, Vol. 5, No. 1, pp. 33–43.) A survey of some numerical methods for studying the performance parameters associated with transient behaviour of switching circuits.

621.319.45 **1741**

Properties and Characteristics of Tantalum Capacitors with Solid Electrolyte.—W. Ackmann. (*Nachrichtentech. Z.*, June 1960, Vol. 13, No. 6, pp. 261–265.)

621.372: 621.391.822: 621.385.2 **1742**

Nonlinear Thermal Fluctuations in a Diode.—N. G. Van Kampen. (*Physica*, Aug. 1960, Vol. 26, No. 8, pp. 585–604.) As an example of nonlinear noise, the fluctuations in a circuit consisting of a diode and a capacitor are studied and the complete fluctuation spectrum is calculated. See also 1098 of 1960 (Alkemade).

621.372.413 **1743**

Time Delay and Frequency Response of Resonant Cavities.—A. G. Mungall & D. Morris. (*Canad. J. Phys.*, Nov. 1960, Vol. 38, No. 11, pp. 1510–1515.) "The frequency response and time delay characteristics of resonant cavities are discussed. It is found that a signal travelling through a resonant cavity undergoes a time delay dependent on both the cavity Q and also the difference between the signal and resonant frequencies. The time delay for a frequency-modulated wave is calculated and checked experimentally."

621.372.44: 517.542.2 **1744**

Application of Distortion Functions to Instantaneous Nonlinear Circuits.—R. Codelupi. (*Note Recensioni Notiz.*, May–June 1960, Vol. 9, No. 3, pp. 489–540.) Mathematical treatment of nonlinear nonreactive networks using the functions derived in 3975 of 1960.

621.372.5 **1745**

The Propagation Coefficient of a General Linear Quadripole.—H. Weber. (*Bull. schweiz. elektrotech. Ver.*, 8th Oct. 1960, Vol. 51, No. 20, pp. 958–960.) Current and voltage relations in a quadripole joining two transmission lines are calculated using methods of image-parameter theory.

621.372.5.029.6 **1746**

Determination of the Characteristic Impedance of Any Quadripole at Microwave Frequencies.—S. Lefeuvre. (*C. R. Acad. Sci., Paris*, 16th May 1960, Vol. 250,

No. 20, pp. 3288–3289.) Measurements made on the quadripole under certain load conditions are used in determining the characteristic impedance by a graphical method.

621.372.54 **1747**

The Modification of Wide-Band Noise Phenomena by Linear Transmission Systems.—H. Schlitt. (*Arch. elekt. Übertragung*, June 1960, Vol. 14, No. 6, pp. 239–246.) For simple types of filters the distortion of the power spectrum and autocorrelation function is investigated with wide-band noise as input. Relations between parameters of classical and of statistical system theory are derived.

621.372.54 **1748**

Method of Investigation of the Four-Branch Reactive Ladder-Filter Section.—J. Bimont. (*Câbles & Transm.*, July 1960, Vol. 14, No. 3, pp. 175–179.) Extension of a graphical method described earlier (3738 of 1960).

621.372.54 **1749**

Antimetric Ladder Filters.—J. E. Colin. (*Câbles & Transm.*, July 1960, Vol. 14, No. 3, pp. 200–219.) All parameters of a quadripole antimetric ladder filter are shown to depend on four polynomial functions of p^2 (p being the complex angular frequency) between which a relation exists. The theory is applied to antimetric band rejection filters and to high- and low-pass filters, and tables are given facilitating calculations.

621.372.54 **1750**

Extension of the Possibilities of Filter Circuit Construction by means of Regions of Imaginary Characteristic Impedance in the Pass Band and Regions of Real Characteristic Impedance in the Stop Band.—W. Herzog. (*Nachrichtentech. Z.*, June 1960, Vol. 13, No. 6, pp. 291–295.) See also 1434 of May.

621.372.54 : 621.374 **1751**

The Choice of Filters with Favourable Transient Characteristics.—O. Herrmann & W. Schüssler. (*Arch. elekt. Übertragung*, April 1960, Vol. 14, No. 4, pp. 183–189.) The design of networks with the desired characteristics for pulse-shaping circuits is based on an analogue-computer method (3737 of 1960 (Schüssler)). Examples are given of filters with idealized response or with transfer function approximated by polynomials.

621.372.54 : 621.375.13.029.4 **1752**

Audio-Frequency Comb Filter.—L. H. Bedford. (*Electronic Technol.*, April 1961, Vol. 38, No. 4, pp. 138–140.) Details are given of the design of a mechanical system consisting of a stretched metallic string for suppressing 50-c/s hum and associated harmonics in the output of an a.f. amplifier. Experimental results are noted.

621.372.6 **1753**

The Scattering Matrix of Generally Interconnected Multipoles.—T. A. Abele. (*Arch. elekt. Übertragung*, June 1960, Vol. 14, No. 6, pp. 262–268.) The scattering matrix of the network is formed by the simple manipulation of matrices based on the scattering matrix of the individual multipoles. See also 3399 of 1960 (Schuon & Wolf).

621.373.029.66 **1754**

Research on Submillimetre Wave Generation and Techniques.—G. E. Weibel. (*Bull. schweiz. elektrotech. Ver.*, 8th Oct. 1960, Vol. 51, No. 20, pp. 1015–1020. In English.) Experiments and experimental equipment are described for investigations on sub-mm-wave generation including a 'tornadotron' in which e.m. radiation is produced by the action of pulsed magnetic fields, of the order of 100 kG, on a trapped electron cloud. Aspects of instrumentation suitable for these frequencies are briefly discussed.

621.373.4 : 621.376.32 **1755**

Frequency Modulation of a Pound Stabilized Oscillator.—K. Leibrecht. (*C. R. Acad. Sci., Paris*, 16th May 1960, Vol. 250, No. 20, pp. 3302–3304.) A method is outlined for applying frequency modulation to an improved Pound stabilized oscillator [355 of 1956 (Hervé)]. The frequency deviation is limited to about 1 Mc/s.

621.373.4.072.9 **1756**

Impulse-Governed Oscillator-Techniques: Part 2.—C. J. de Lussanet de la Sablonière. (*Philips Telecommun. Rev.*, Sept. 1960 & Jan. 1961, Vol. 22, Nos. 1 & 2, pp. 32–46 & 94–101.) Theoretical aspects of i.g.o. techniques are given. Part 1: 3754 of 1960.

621.373.42.029.6 : 621.018.41(083.74) **1757**

Microwave Generators for the I.E.N. Caesium Standard.—G. Zito. (*Bull. schweiz. elektrotech. Ver.*, 8th Oct. 1960, Vol. 51, No. 20, pp. 1075–1079. In English.) Two microwave generators are described which are used in the atomic frequency standard of the Istituto Elettrotecnico Nazionale in Turin for Cs resonance excitation by molecular-beam technique. Measurements of phase drift and frequency stability are also considered.

621.373.422 **1758**

Plate Voltage Control of Phantastron Frequency.—W. C. Whitworth. (*Electronics*, 10th Feb. 1961, Vol. 34, No. 6, pp. 73–74.) "Two pentodes, each forming a phantastron circuit, are interconnected so that both mark and space of their combined output waveforms are controlled by linear rather than exponential sweeps. Circuit jitter is less than 0·003%, at 5 pulses/sec repetition rate."

621.373.422 : 621.382.333 **1759**

Phantastron Circuits using Transistors.—N. C. Hekimian. (*Electronics*, 24th Feb. 1961, Vol. 34, No. 8, pp. 46–47.) Arrangements of three transistors to simulate the screen-anode current partition of a pentode enable transitron-type circuits to be designed.

621.373.43 : 621.374.32 **1760**

The Eccles-Jordan Circuit with Transistors for High-Speed Counters.—W. Hilberg. (*Telefunken Ztg.*, June 1960, Vol. 33, No. 128, pp. 90–108. English summary, p. 136.) A static analysis of a transistor flip-flop circuit is given and the counting frequency limits for high-speed counters consisting of balanced flip-flop elements are discussed. Circuits operating at frequencies in excess of 20 Mc/s are described.

621.373.43 : 621.382.23 **1761**

One-Tunnel-Diode Flip-Flop.—R. A. Kaenel. (*Proc. Inst. Radio Engrs*, March 1961, Vol. 49, No. 3, p. 622.) A note on the operation of a simple bistable device.

621.373.43 : 621.382.23 **1762**

Designing Tunnel-Diode Oscillators.—W. H. Ko. (*Electronics*, 10th Feb. 1961, Vol. 34, No. 6, pp. 68–72.) Analysis of relaxation oscillators and associated circuits for sine-wave and square-wave generation.

621.374.3 **1763**

Mathematical Analysis of Pulse Networks.—R. Hofmann. (*Arch. elekt. Übertragung*, June 1960, Vol. 14, No. 6, pp. 255–261.) Linear systems are analysed which comprise an element capable of converting a continuous input function into pulses of any desired shape. A pulse-network equation is derived which is applicable to closed-loop control systems.

621.374.3 **1764**

The Generation of Very Short Needle-Shaped Pulses.—H. P. Louis. (*Bull. schweiz. elektrotech. Ver.*, 8th Oct. 1960, Vol. 51, No. 20, pp. 1067–1072.) The design of pulse generators and pulse-shaping networks is discussed. Details are given of a double-differentiating network for the generation of 0·35-ns pulses of 400-mV amplitude; further improvements by means of tunnel diodes appear possible.

621.374.33 : 621.387.4 **1765**

Low-Level Linear Microsecond Gate.—P. R. Chagnon. (*Rev. sci. Instrum.*, Jan. 1961, Vol. 32, No. 1, pp. 68–70.) A six-diode gate, linear over the range 0–01–5 V is described.

621.374.5 **1766**

A Solenoid Delay Line with Constant Delay.—A. J. Gigov. (*Bull. schweiz. elektrotech. Ver.*, 8th Oct. 1960, Vol. 51, No. 20, pp. 960–962.) Description of a compact delay line which consists of a solenoid wound on a ceramic tube of high dielectric constant with a metal core. Delay can be made independent of frequency with an appropriate ratio core diameter/coil.

621.374.5 : 538.2-6 **1767**

The Effect of an Intermediate Layer on the Frequency Characteristics of Ultrasonic Delay Lines.—K. S. Alexandrov, L. S. Gurevich & E. I. Kamenskii. (*Akust. Zh.*, 1960, Vol. 6, No. 2, pp. 171–179.) General expressions are derived for the line conversion factor taking account of an intermediate layer between the transducer and the line. The effect of this layer on the frequency characteristics and transmission band is considered and the relevant characteristics of different transducer and layer materials are tabulated.

621.375.029.6 : [621.385.6 + 621.382.23] **1768**

Amplificateurs-Modèles Transdo, Techniques and Problèmes.—Nergaard. (See 2044.)

621.375.432 **1769**

The Behaviour of a Nonlinear Transistor Amplifier in the Region of its Stability Limit.—I. Gumowski. (*C. R. Acad. Sci., Paris*, 9th May 1960, Vol. 250, No. 19, pp. 3142–3144.) An extension of earlier work (4150 of 1960 and 801 of March). The limit of stability of the amplifier is established from the form of the solution of a first-order differential equation describing the amplifier.

621.375.432 **1770**

Transistor Amplifiers with Feedback.—E. R. Hauri. (*Tech. Mitt. PTT*, 1st June & 1st July 1960, Vol. 38, Nos. 6 & 7, pp. 185–200 & 220–236.) Analysis of the properties of transistor amplifiers using the *h* parameters. Feedback circuits with special characteristics are reviewed. Over 40 references.

621.375.9: 537.311.33 **1771**

Semiconductor Amplifiers and Generators with Carriers having Negative Effective Mass.—N. G. Basov, O. N. Krokhin & Yu. M. Popov. (*Zh. eksp. teor. Fiz.*, March 1960, Vol. 38, No. 3, pp. 1001–1002.) It is not possible to produce states with negative losses in a semiconductor by means of a constant electric field; it is necessary to have a state with negative temperature as achieved in molecular generators or using pulsed excitation by an electric field.

621.375.9: 538.569.4 **1772**

Cross-Relaxation Masers.—G. S. Bogle. (*Proc. Inst. Radio Engrs*, March 1961, Vol. 49, No. 3, pp. 573–590.) The ways in which ruby, spinel, rutile and emerald can amplify at frequencies small compared with their zero-field splitting frequencies are surveyed. Cross-relaxation is shown to give a two-fold improvement in maser performance. Analytic expressions for the energies are given.

621.375.9: 538.569.4 **1773**

Inverse Maser Operation.—P. A. Forrester & W. B. Hines. (*J. appl. Phys.*, Feb. 1961, Vol. 32, No. 2, pp. 317–320.) "Cross-relaxation between adjacent intervals may be used to secure an advantage in maser operation comparable to that obtained by 'push-pull' pumping. Equations for the rate of change of populations in a scheme of four levels (*A, B, C, D*) where *BC* is pumped and cross-relaxation takes place between *BC*, *CD* have been formulated, and the steady-state condition corresponding to various assumptions regarding lattice relaxation times is discussed. In an experimental investigation of maser operation based on this scheme and using ruby as the active material, an inversion of (*B*–*C*) : 1 was obtained at a signal frequency of 14·5 Gc/s when pumping at 24·5 Gc/s."

621.375.9: 621.372.44 **1774**

Travelling-Wave Parametric Amplifier Analysis using Difference Equations.—H. Fischer. (*Proc. Inst. Radio Engrs*, March 1961, Vol. 49, No. 3, pp. 586–586.) A second-order difference equation is derived for both periodically and uniformly distributed parametric amplifiers. Gain and voltage output are calculated. The results are specifically applied to an 11-element parametric amplifier.

621.375.9: 621.372.44 **1775**

Effect of Upper Sidebands in Travelling-Wave Parametric Amplifiers.—A. Dayem. (*Bull. schweiz. elektrotech. Ver.*, 8th Oct. 1960, Vol. 51, No. 20, pp. 1054–1061. In English.) The effect of higher sidebands on paramagnetic amplification is investigated for circuits of limited bandwidth and infinite bandwidth [see e.g. 3240 of 1959 (Roe & Boyd)].

621.375.9: 621.372.44: 523.164 **1776**

Theoretical Considerations regarding the Application of Parametric Amplifiers to Radio Telescopes.—W. Drury & H. Rickenbach. (*Bull. schweiz. elektrotech. Ver.*, 8th Oct. 1960, Vol. 51, No. 20, pp. 1061–1067.) The improvement of resolving power obtained by using one parametric amplifier immediately preceding the aerial and another as preamplifier stage of the receiver is discussed.

621.375.9: 621.372.44: 523.164 **1777**

Parametric Amplifier for Space Probe Tracking.—C. F. Brett. (*Electronics*, 27th Jan. 1961, Vol. 34, No. 4, pp. 41–45.) Description of the parametric amplifier used with the Jodrell Bank Radio telescope for reception of the Pioneer V space probe signals from distances of over $2\frac{1}{2} \times 10^8$ miles. A description of a parametric-amplifier tester using transistors is included.

621.375.9: 621.372.44: 538.221 **1778**

Parametric Circuits at Low Frequencies using Ferrites and Thin Magnetic Films.—A. Bramley. (*Bull. schweiz. elektrotech. Ver.*, 8th Oct. 1960, Vol. 51, No. 20, pp. 1046–1053. In English.) The design of parametric circuits incorporating ferrite cores and films with nonlinear *B-H* characteristics is discussed. Films appear to be more suitable for operation at higher frequencies. An advantage of the use of ferrite and magnetic-film devices is their resistance to nuclear radiation.

621.375.9: 621.372.44: 621.385.3 **1779**

The Gaussmeter Tube as a Parametric Frequency Divider and Amplifier.—R. S. Elves & J. Nee. (*Proc. Inst. Radio Engrs*, March 1961, Vol. 49, No. 3, pp. 624–625.) Derivation of the equivalent circuit of a parametric amplifier in which a resistance valve functions as a time-varying inductance. If the signal source is removed the circuit will operate as a frequency divider, where the output is a subharmonic of the pump frequency.

621.375.9: 621.372.44: 621.385.63 **1780**

Energy Gainers in a Parametric Electron-Beam Amplifier.—Grace. (*See* 2046.)

621.375.9: 621.372.44: 621.385.63 **1781**

Coupled-Mode Theory of Electron-Beam Parametric Amplification.—Cassedy & Johnston. (*See* 2047.)

621.375.9: 621.372.44: 621.385.63 **1782**

A Cyclotron Wave Amplifier with Magnetic Pumping.—Rohrer. (*See* 2048.)

621.375.9:669.71: 621.382.23 **1783**

Designing Tunnel-Diode R.F. Amplifiers.—E. D. Long & C. P. Womack. (*Electronics*, 17th Feb. 1961, Vol. 34, No. 7, pp. 120–123.) A strip-line filter and tunnel diode are combined to give low-noise amplification at u.h.f. in a small module.

GENERAL PHYSICS

537.291 **1784**

Time-Averaged Effects on Charged Particles in A.C. Fields.—T. W. Johnston. (*RCA Rev.*, Dec. 1960, Vol. 21, No. 4, pp. 570–610.) The basic theory is developed and applied to plasmas, including some cases with a d.c. magnetic field. A bibliography and a critique of theory and experiments are included.

537.32 **1785**

Transient Response of a Thermocouple Circuit under Steady Currents.—A. D. Reich & J. R. Madigan. (*J. appl. Phys.*, Feb. 1961, Vol. 32, No. 2, pp. 294–301.)

537.533 **1786**

Experimental Study of Anomalous Electron Stream Behaviour.—M. H. Miller & W. G. Dow. (*J. appl. Phys.*, Feb. 1961, Vol. 32, No. 2, pp. 274–281.) Experimental measurements on the characteristics of the sole current in a rectilinear crossed-field beam are reported. The sole current may be assigned a kinetic temperature of the order of 10 V corresponding to energy in excess of that corresponding to motion in static fields. The energy exchange leading to this excess energy is believed to be associated with multiple-loop trajectories in the low-potential region near the cathode.

537.54: 621.391.822 **1787**

Noise Generated in the Ion Sheath of a Probe.—K. Shimada. (*Proc. Inst. Radio Engrs*, March 1961, Vol. 49, No. 3, pp. 632–633.) The frequency-dependence of I_{rms}, the saturated diode current, is examined theoretically and results obtained are compared with measured values.

537.56 **1788**

The General Theory of the Motions of Ions and Electrons in Gases.—L. G. H. Huxley. (*Aust. J. Phys.*, Dec. 1960, Vol. 13, No. 3, pp. 710–737.) The fundamental equations for drift velocities and diffusion coefficients of ions and electrons in gases are derived in general form by the application of kinematical principles.

537.56 **1789**

An Error in the Thermal Conductivity for a Fully Ionized Gas.—R. W. Vaughan-Williams & F. A. Haas. (*Phys. Rev. Lett.*, 15th Feb. 1961, Vol. 6, No. 4, pp. 165–166.) A discrepancy between formulae of Marshall and of Rosenbluth & Kaufmann (1799 of 1958) is due to an error in the last collision integral of Marshall.

537.56 **1790**

The Investigation of High-Frequency Plasmas by means of a D.C. Probe.—H. Fetz & H. Grabarse. (*Z. angew. Phys.*, June 1960, Vol. 12, No. 6, pp. 250–258.)

537.56 **1791**

Instability of Longitudinal Oscillations of an Electron-Ion Plasma.—I. M. Kovrizhnykh & A. A. Rukhadze. (*Zh. eksp. teor. Fiz.*, March 1960, Vol. 38, No. 3, pp. 850–855.) In an isotropic plasma the oscillations are always damped; in an anisotropic medium ion motion may lead to instability.

537.56: 537.533 **1792**

Interaction of an Electron Beam with Plasma.—I. F. Kharchenko, Ya. B. Fainberg, R. M. Nikolaev, E. A. Kornilov, E. A. Lutsenko & N. S. Pedenko. (*Zh. eksp. teor. Fiz.*, March 1960, Vol. 38, No. 3, pp. 685–692.) An experimental investigation of modulated and unmodulated beams of high-energy electrons with a high-frequency discharge plasma is reported. When an unmodulated beam moves through the plasma, oscillations are produced in the beam at frequencies close to the plasma frequency.

537.56: 537.533 **1793**

Interaction of an Electron Beam with a Fully Ionized Plasma.—M. A. Allen & G. S. Kino. (*Phys. Rev. Lett.*, 15th Feb. 1961, Vol. 6, No. 4, pp. 163–165.) An electron beam, modulated at microwave frequency ω, passes through a thermal Cs plasma (critical frequency ω_p, cyclotron frequency ω_c). Gain in beam modulation amplitude is measured. Theory is outlined, which predicts gain for $\omega_c^2 < \omega^2 < \omega_c^2 + \omega_p^2$, with a maximum at $\omega = \omega_p$. Preliminary experiments agree with theoretical predictions. A measured gain >20 dB at 3 Gc/s is reported.

538.24 **1794**

Magnetic Polarizability of a Short Right Circular Conducting Cylinder.—T. T. Taylor. (*J. Res. nat. Bur. Stand.*, Oct.–Dec. 1960, Vol. 64B, No. 4, pp. 199–210.) A comprehensive mathematical analysis using a method given earlier (488 of February).

538.311: 537.312.62 **1795**

Production of Magnetic Fields exceeding 15 Kilogauss by a Superconducting Solenoid.—J. E. Kunzler, E. Buehler, F. S. L. Hsu, B. T. Matthias & C. Wahl. (*J. appl. Phys.*, Feb. 1961, Vol. 32, No. 2, pp. 325–326.) Experiments with Mo_3Re in wire form are described. Critical-field data are given.

538.561: 539.124 **1796**

Cherenkov Radiation of a Particle Possessing a Charge and an Intrinsic Magnetic Moment.—Li Men Kha (Li Meng-Ha). (*Zh. eksp. teor. Fiz.*, March 1960, Vol. 38, No. 3, pp. 934–936.) Analysis, by quantum electrodynamic methods, of the effect of the spin on the intensity and polarization of the radiation produced in a ferrite by a charged particle with an intrinsic magnetic moment.

538.566 + 534.2 **1797**

Energy-Momentum Tensor for Plane Waves.—P. A. Sturrock. (*Phys. Rev.*, 1st Jan. 1961, Vol. 121, No. 1, pp. 18–19.) A general form is established for the energy momentum tensor for plane waves propagating in a homogeneous medium, the field equations of which are derivable from a quadratic Lagrangian function.

538.566 + 534.2 **1798**

Limit of Applicability of the Method of 'Smooth' Perturbations in the Problem of Wave Propagation through a Medium with Inhomogeneities.—V. V. Pisareva. (*Akust. Zh.*, 1960, Vol. 6, No. 1, pp. 87–91.) Mean square values of the phase and amplitude fluctuations and of the amplitude correlation function are discussed. Conditions are determined under which the effect of the layer with inhomogeneities on the traversing radiation can be replaced by the perturbation action of an equivalent phase screen.

538.566: 535.42] + 534.26 **1799**

Diffraction of a Scalar Wave by a Slit and by a Circular Aperture in a Screen of Arbitrary Thickness.—M. V. Butrov. (*Akust. Zh.*, 1960, Vol. 6, No. 1, pp. 16–22.) An expression is derived for the transmission coefficient, and its variation as a function of screen thickness and aperture size is plotted.

538.566: 535.42 **1800**

An Electromagnetic Diffraction Problem involving Unidirectionally Conducting Surfaces.—R. A. Hurd. (*Canad. J. Phys.*, Oct. 1960, Vol. 38, No. 10, pp. 1229–1244.) The exact value of the e.m. field scattered by a unidirectionally conducting surface under plane-wave excitation is obtained. The surface, which is an entire plane, is the junction of two unidirectionally conducting half-planes whose conductivity directions are inclined at an arbitrary angle to each other, and to the boundary line.

538.566: 535.42 **1801**

On the Theory of Diffraction by a Composite Cylinder.—R. D. Kodis. (*J. Res. nat. Bur. Stand.*, Jan./Feb. 1961, Vol. 65D, No. 1, pp. 19–33.) General formulae are developed for the diffraction field around a perfectly conducting cylinder with a dielectric sleeve. These formulae represent the field due to a unit electric line source parallel to the cylinder. Limiting cases are examined.

538.566: 537.56 **1802**

Gyro-resonance Absorption of Electromagnetic Waves in a Plasma.—B. N. Gershman. (*Zh. eksp. teor. Fiz.*, March 1960, Vol. 38, No. 3, pp. 912–924.) An earlier analysis (1476 of May) is extended to frequencies near the gyro-frequency and multiples of this, taking account of the thermal motion of electrons.

538.566.029.64: 530.17: 535.43 **1803**

Microwave Analogue to the Scattering of Light by Nonspherical Particles.—J. M. Greenberg, N. E. Pedersen & J. C. Pedersen. (*J. appl. Phys.*, Feb. 1961, Vol. 32, No. 2, pp. 233–242.) Total scattering cross-sections and angular distributions have been measured; some approximate theoretical methods appear to be useful. The results are referred to the effects of interstellar matter on starlight.

538.569.4: 535.853 **1804**

Paramagnetic Resonance Spectroscopy at Zero Magnetic Field.—G. S. Bogle, H. F. Symmons, V. E. Bowers & J. V. Sierins. (*Proc. phys. Soc.*, 1st March 1961, Vol. 77, No. 495, pp. 561–566.) Two spectrometers covering the range 0–48 Gc/s are described.

538.569.4: 535.853: 621.316.726 **1805**

Frequency Stabilization Scheme for the Pound-Watkins R.F. Spectrometer.—J. Jerner. (*Rev. sci. Instrum.*, Jan. 1961, Vol. 32, No. 1, pp. 27–28.) "A scheme is described for locking the frequency of a marginal-oscillator r.f. spectrometer to that of an external standard. This makes it convenient to use such a spectrometer for high-resolution NMR work."

538.569.4: 535.853: 621.375.9 **1806**

Comparison of the Sensitivities of the Beam Maser and Cavity Absorption Spectrometers.—Y. Beers. (*Rev. sci. Instrum.*, Jan. 1961, Vol. 32, No. 1, pp. 23–27.) A formula is derived for the signal/noise ratio of the beam maser considering it as a special case of cavity spectrometer. The sensitivity of the maser relative to the spectrometer varies inversely with the frequency.

538.569.4: 538.221 **1807**

Restoration of Stability in Ferromagnetic Resonance.—H. Suhl. (*Phys. Rev. Lett.*, 15th Feb. 1961, Vol. 6, No. 4, pp. 174–176.) The threshold r.f. power for subsidiary absorption can be increased by a small a.c. modulation of the d.c. magnetic field.

538.569.4: 621.373.421.1 **1808**

High Level Oscillator for Nuclear Resonance.—W. D. Knight. (*Rev. sci. Instrum.*, Jan. 1961, Vol. 32, No. 1, p. 95.) A modification of the cathode-coupled circuit [see e.g. 1972 of 1960 (Robinson)] which functions at r.f. levels in the range 1–10 V r.m.s.

538.569.4: 621.375.9: 535.61-1/2 **1809**

Theory of LASER Oscillation in Fabry-Perot Resonators.—J. Kotik & M. C. Newstein. (*J. appl. Phys.*, Feb. 1961, Vol. 32, No. 2, pp. 178–186.) An approximate condition for oscillation is derived.

538.569.4: 621.375.9: 535.61-2 **1810**

Stimulated Optical Emission from Exchange-Coupled Ions of Cr^{+++} in Al_2O_3.—I. Wieder & L. R. Sarles. (*Phys. Rev. Lett.*, 1st Feb. 1961, Vol. 6, No. 3, pp. 95–96.)

538.569.4: 621.375.9: 535.61-2 **1811**

Simultaneous Optical Maser Action in Two Ruby Satellite Lines.—A. L. Schawlow & G. E. Devlin. (*Phys. Rev. Lett.*, 1st Feb. 1961, Vol. 6, No. 3, pp. 96–98.) Maser oscillations have been obtained simultaneously at wavelengths of 7 009 Å and 7 041 Å in concentrated ruby.

538.569.4: 621.375.9: 535.61-2 **1812**

Population Inversion and Continuous Optical Maser Oscillation in a Gas Discharge containing a He-Ne Mixture.—A. Javan, W. R. Bennett, Jr, & D. R. Herriott. (*Phys. Rev. Lett.*, 1st Feb. 1961, Vol. 6, No. 3, pp. 106–110.) Experimental data on the physical properties of the system are discussed.

[illegible] 1814

Radio Wave Absorption of Several Gases in the 100 to 117 kMc/s Frequency Range.—C. O. Britt, C. W. Tolbert & A. W. Straiton. (*J. Res. nat. Bur. Stand.*, Jan.–Feb. 1961, Vol. 65D, No. 1, pp. 15–18.) An extension of earlier work (2699 of 1960 Straiton & Tolbert) to the gases CO, N_2O, SO_2 and NO_2. They were contained within a 6½-in.-diameter tube up to 500 ft long, and a wide pressure range was used.

[illegible] 1815

Precise Measurement of the Microwave Absorption Frequencies of the Oxygen Molecule and the Velocity of Light.—R. W. Zimmerer & M. Mizushima. (*Phys. Rev.*, 1st Jan. 1961, Vol. 121, No. 1, pp. 152–155.) "Ten microwave absorption frequencies of the oxygen molecule in the 60-Gc/s region have been measured with an accuracy of about 10 kc/s. The result is interpreted by successfully refining the existing theory. Comparing the resultant value of the rotational constant B_0 with the value obtained in ultraviolet spectra, the velocity of light is calculated to be 299 773 ±12 km/s."

GEOPHYSICAL AND EXTRATERRESTRIAL PHENOMENA

523.164 **1815**

A Catalogue of Radio Sources between Declinations −20° and −50°.—B. Y. Mills, O. B. Slee & E. R. Hill. (*Aust. J. Phys.*, Dec. 1960, Vol. 13, No. 4, pp. 676–699.) This list of 892 sources supplements a previous catalogue for declinations between +10° and −20° (423 of 1959). Angular sizes of 50 of the strongest sources are given, several of these being less than 15″ arc in size.

523.164: 621.396.62 **1816**

A 75-cm Receiver for Radio Astronomy and some Observational Results.—C. L. Seeger, F. L. H. M. Stumpers & N. van Hurck. (*Philips tech. Rev.*, 27th Sept. 1960, Vol. 21, No. 11, pp. 317–333.) Description of a superheterodyne receiver in which the h.f. amplifier contains two disk-seal triode valves in cascode, the effective cathode resistance of the second valve being made very high by a simple neutralization circuit. A noise factor of 2·5 has been obtained at 400 Mc/s. Radio-astronomy observations are described which have been made with this receiver and the 25-m parabolic reflector at Dwingeloo. An isophot chart of the sky drawn from these observations is reproduced.

523.164: 621.396.677 **1817**

An Interferometer for the Measurement of Radio-Source Sizes.—B. R. Goddard, A. Watkinson & B. Y. Mills. (*Aust. J. Phys.*, Dec. 1960, Vol. 13, No. 4, pp. 665–675.) The 85·5-Mc/s cross-type radio telescope at Sydney [1126*g* of 1958 (Mills et al.)] has been modified to study sources in the range 10″–1′ arc. The instrument and its operation are described.

523.164: 621.396.677.5: 6 **1818**

Direction-Finding on Diffuse Sources of Electromagnetic Radiation.—D. G. Cartwright. (*Aust. J. Phys.*, Dec. 1960, Vol. 13, No. 4, pp. 712–717.) By combining the characteristics of an Adcock type and rotating-loop type of direction-finder the position and size of an extended source can be determined.

523.164.3 **1819**

An Attempt to Detect Linear Polarization in the Galactic Background Radiation at 215 Mc/s.—J. L. Pawsey & E. Sharing. (*Aust. J. Phys.*, Dec. 1960, Vol. 13, No. 4, pp. 740–742.) Observations of a strip of sky about declination 34°S set an upper limit of 1% to the degree of linear polarization for bandwidths of 1 Mc/s, 700 and 300 kc/s.

523.164.32 **1820**

Recent Developments in Solar Radio Astronomy.—A. Maxwell. (*Proc. nat. Acad. Sci., Wash.*, Sept. 1960, Vol. 46, No. 9, pp. 1260–1269.) A review with 24 references.

523.164.32 **1821**

The Radio Brightness of the Quiet Sun at 21 cm Wavelength near Sunspot Maximum.—N. R. Labrum. (*Aust. J. Phys.*, Dec. 1960, Vol. 13, No. 4, pp. 700–711.) The quiet-sun temperature, measured using pencil-beam and fan-beam techniques, is approximately 140 000°K. This value is twice that for the same wavelength at sunspot minimum.

523.164.32: 523.75 **1822**

Investigation of the Relative Positions of Solar Radio Storm Sources and of Associated Optical Centres of Activity.—É. J. Blum & A. M. Malinge. (*C. R. Acad. Sci., Paris*, 9th May 1960, Vol. 250, No. 19, pp. 3119–3121.) A comparison has been made between the mean positions of radio storm centres observed on 169 Mc/s and optically observed sunspots. Results show a systematic difference between the apparent and true positions of the former and, for more intense storm centres, a directivity effect with latitude.

523.164.32: 550.385.4 **1823**

Solar Radio Emissions and Geophysical Disturbances during July 1959.—M. P. Hughes. (*J. geophys. Res.*, Feb. 1961, Vol. 66, No. 2, pp. 651–653.)

523.164.4 **1824**

Cosmological Significance of Angular Measurements of Distant Radio Sources.—W. Davidson. (*Nature, Lond.*, 25th March 1961, Vol. 189, No. 4769, pp. 991–992.)

523.165 **1825**

Solar-Produced Cosmic Rays near the North and South Poles.—M. A. Pomerantz, S. P. Duggal & K. Nagashima. (*Phys. Rev. Lett.*, 1st Feb. 1961, Vol. 6, No. 3, pp. 123–125.) Results of ground observations during the storms of 12th and 15th November 1960 are presented.

523.165 **1826**

X Rays from Van Allen Belt Electrons.—J. B. Cladis & A. J. Dessler. (*J. geophys. Res.*, Feb. 1961, Vol. 66, No. 2, pp. 345–350.) It ought to be possible to detect the X-ray flux, at peak intensity, above the cosmic radiation background, at balloon altitudes.

523.165 **1827**

Electrons in the Primary Cosmic Radiation.—P. Meyer & R. Vogt. (*Phys. Rev. Lett.*, 15th Feb. 1961, Vol. 6, No. 4, pp. 193–196.) Extraterrestrial electrons with energies in the range 25–1 300 MeV and greater have been observed on three balloon flights.

523.165 **1828**

Charged Particles in the Inner Van Allen Radiation Belt.—A. H. Armstrong, F. B. Harrison, H. H. Heckman & L. Rosen. (*J. geophys. Res.*, Feb. 1961, Vol. 66, No. 2, pp. 351–357.) Results are given for the flight through the inner Van Allen belt of emulsion stacks carried in an Atlas rocket. The measured proton energy spectrum was in accord with a cosmic ray albedo source down to 100 MeV. However, below 100 MeV the spectrum exhibits structure with a maximum at 80 MeV and a minimum at 60 MeV. Penetration of solar protons into the belt over a period of days can explain the effect.

523.165: 539.16 **1829**

Hydromagnetic Waves and the Trapped Radiation: Parts 1 & 2.—D. G. Wentzel. (*J. geophys. Res.*, Feb. 1961, Vol. 66, No. 2, pp. 359–369.) A theoretical discussion and comments on the results of the Argus experiment.

523.746.5 **1830**

An Estimate of the Peak Sunspot Number in 1968.—C. M. Minnis. (*J. atmos. terr. Phys.*, March 1961, Vol. 20, Nos. 2/3, pp. 94–99.) Detailed analysis of the statistical properties of the twenty peaks in the sunspot cycle since 1761, results of which were given earlier (2341 of 1960).

523.75: 523.164.32 **1831**

Unusual Solar Disturbance.—(*Tech. News. Bull. nat. Bur. Stand.*, Aug. 1960, Vol. 44, No. 8, pp. 138–139.) No solar flare could be observed at the time of a radio disturbance of importance 3+ at 1638 U.T. on 9th June 1959. The flare became observable after a delay of 1½ h. This and other anomalies are discussed in relation to two assumptions concerning the flare: (*a*) that it occurred on the far side of the sun, (*b*) that it originated at a lower level in the sun's atmosphere than the source of r.f. emissions.

550.385.37 **1832**

Geomagnetic Micropulsations.—G. R. A. Ellis. (*Aust. J. Phys.*, Dec. 1960, Vol. 13, No. 4, pp. 625–632.) Simultaneous observations of geomagnetic pulsations at geomagnetic latitudes 28°S, 42°S and 51°S showed no change in period with latitude but a monotonic increase in amplitude with latitude for periods between 10 and 100 sec. The interpretation of these results is discussed.

550.385.4 **1833**

The Simultaneity of Geomagnetic Sudden Impulses.—M. Yamamoto & H.

Macda. (*J. atmos. terr. Phys.*, March 1961, Vol. 20, Nos. 2/3, pp. 212–215.) Analysis of several events during the I.G.Y. shows that sudden impulses are propagated from high latitudes to low latitudes in times of about 1 min.

551.507.362.2 **1834**

The Theory of Artificial Satellites in Terms of the Orbital True Longitude.—P. Musen. (*J. geophys. Res.*, Feb. 1961, Vol. 66, No. 2, pp. 403–409.) Previous theory (1589 of 1960) has been developed in terms of orbital true longitude and leads to faster convergence for large eccentricities and to a smaller number of terms in the series representing the perturbations.

551.507.362.2 : 621.391.812.3 **1835**

On the Large-Scale Regions of Irregularities Producing Scintillation of Signals Transmitted from Earth Satellites.—J. Frihagen & J. Tröim. (*J. atmos. terr. Phys.*, March 1961, Vol. 20, Nos. 2/3, pp. 215–216.) Evidence is presented which indicates that absence of scintillation is not due primarily to high aspect sensitivity of scattering from field-aligned irregularities.

551.507.362.2 : 621.391.812.3 **1836**

Ionospheric Scattering of Satellite Transmissions.—J. Mawdsley & I. R. Richards. (*Nature, Lond.*, 18th March 1961, Vol. 189, No. 4768, pp. 906–907.) Reports of observations of night-time scintillations of satellite transmissions are briefly analysed in relation to the position of the observing station and the direction of passage of the satellite. Results demonstrate the ability of field-aligned irregularities to scatter *m*-λ radio waves in a manner highly sensitive to aspect. See also 1160 of April (Bain).

551.507.362.2 : 621.391.812.34 **1837**

Observed Field Strength in the Neighbourhood of the Skip Distance.—K. C. Yeh & G. W. Swenson, Jr. (*J. geophys. Res.*, Feb. 1961, Vol. 66, No. 2, pp. 654–656.) Examples of ray focusing due to the satellite 1958δ_2 crossing the skip-distance boundary are given. The skip distance agrees well with values derived from ionograms.

551.510.535 **1838**

Ion-Neutral Reactions.—M. Hertzberg. (*J. atmos. terr. Phys.*, March 1961, Vol. 20, Nos. 2/3, pp. 177–182.) A list is given of reactions which may control the chemical composition of positive ions in the ionosphere. Under certain assumptions about reaction rate coefficients, nitrogen is substantially dissociated in the F region, contrary to the theoretical conclusions of other investigators.

551.510.535 **1839**

A Preliminary Model for the Variations of Upper Air Densities.—H. K. Paetzold. (*Nature, Lond.*, 1st April 1961, Vol. 190, No. 4770, pp. 35–36.) A model is proposed covering variations of density with a period greater than one day.

551.510.535 **1840**

The Highest Parts of the Ionosphere.—J. A. Ratcliffe. (*Quart. J.R. met. Soc.*, Oct. 1959, Vol. 85, No. 366, pp. 321–331.) The text is given of the Symons Memorial Lecture, 1959, reviewing current theories concerning the formation and structure of the ionosphere above 150 km.

551.510.535 **1841**

Incoherent Scattering by Free Electrons as a Technique for Studying the Ionosphere and Exosphere: some Observations and Theoretical Considerations.—K. L. Bowles. (*J. Res. nat. Bur. Stand.*, Jan./Feb. 1961, Vol. 65D, No. 1, pp. 1–14.) Observations confirm the existence of the incoherent scatter at predicted levels but indicate less Doppler broadening than expected, for which an explanation is offered.

551.510.535 **1842**

A Possibility for Determining the Existence of a Permanent Form of Magnetic Field-Aligned Ionization Irregularities.—R. L. Leadabrand. (*Proc. Inst. Radio Engrs*, March 1961, Vol. 49, No. 3, pp. 639–640.) Incoherent scatter from a direction perpendicular to the earth's magnetic field is discussed.

551.510.535 **1843**

Internal Atmospheric Gravity Waves at Ionospheric Heights.—C. O. Hines. (*Canad. J. Phys.*, Nov. 1960, Vol. 38, No. 11, pp. 1441–1481.) Irregularities and irregular motions observed in the upper atmosphere are interpreted in terms of a spectrum of waves propagated upwards and modified to produce different dominant modes at different heights.

551.510.535 **1844**

Vertical Characteristics of Travelling Ionospheric Disturbances.—L. H. Heisler. (*Aust. J. Phys.*, Dec. 1960, Vol. 13, No. 4, pp. 655–664.) A comparison between the occurrence of disturbances on fixed-frequency records and $N(h)$ profiles for the same period reveals that (*a*) there appears to be an upper limiting height for the occurrence of disturbances on fixed frequency, and (*b*) the direction of travel of disturbances is related to season only and seems unrelated to height in the ionosphere.

551.510.535 **1845**

The Analysis of Night-Time $h'(f)$ Records.—J. Titheridge. (*J. atmos. terr. Phys.*, March 1961, Vol. 20, Nos. 2/3, pp. 209–212.) A correction of electron density profiles for errors due to underlying ionization, by the use of the extraordinary ray.

551.510.535 **1846**

Theoretical World Curves of Maximum F_2 Ionization: Part 2.—J. E. C. Gliddon & P. C. Kendall. (*J. atmos. terr. Phys.*, March 1961, Vol. 20, Nos. 2/3, pp. 183–188.) A time-dependent solution of the continuity equation, including vertical diffusion of ionization, is used to obtain a theoretical variation of maximum F_2-layer electron density with latitude and local time. Some similarity to experimental data is found, but the equatorial 'trough' does not occur in the theoretical solution. See also 2738 of 1960.

551.510.535 **1847**

On the Influence of Horizontal Motion of the Neutral Air on the Diffusion Equation of the F Region.—J. P. Dougherty. (*J. atmos. terr. Phys.*, March 1961, Vol. 20, Nos. 2/3, pp. 167–176.) The equations of motion of a plasma in applied fields are discussed with reference to the F region. The plasma sets the neutral air into motion horizontally within about ½ h, but is not free to move vertically. The consequences of this result, on a worldwide scale, are discussed.

551.510.535 : 550.385.36 **1848**

Movements of the F Layer of the Ionosphere during Geomagnetic Bay Disturbances.—H. Kohl. (*Arch. elekt. Übertragung*, April 1960, Vol. 14, No. 4, pp. 169–176.) The vertical movement of the F layer during and after geomagnetic disturbances is evaluated from ionospheric soundings made at Lindau, Germany. The movement is treated theoretically on the basis of the plasma theory developed by Lucas & Schlüter (2085 of 1954), and to account for the rise of the layer use is made of Martyn's theory allowing for the influence of the neutral gas. By comparing calculated and measured data estimates of conductivity and neutral-gas density in the ionosphere can be made.

551.510.535 : 550.385.4 **1849**

The Occurrence of the Spread-F and the Geomagnetic Field.—T. Shimazaki. (*J. Radio Res. Labs, Japan*, Sept. 1960, Vol. 7, No. 33, pp. 437–450.) Spread-F is more probable in days after a sudden commencement at high latitudes, and less probable at low latitudes, especially at the equinoctial seasons. There is a strong correlation between the magnitude of the geomagnetic field and the occurrence of spread-F at low latitudes; a turbulence mechanism is suggested to explain this.

551.510.535 : 551.507.362.1 **1850**

Measurement of Positive-Ion Density in the Ionosphere by Sounding Rocket.—T. Ichimiya, K. Takayama, T. Dote, Y. Aono, K. Hirao, S. Miyazaki, T. Sugiyama & T. Muraoka. (*Nature, Lond.*, 8th April 1961, Vol. 190, No. 4771, pp. 156–158.) Preliminary results are given of measurements made over the Akita Rocket Range, Japan, in September 1960. Two rockets were launched, one during the daytime and one at night, each equipped with a spherical Langmuir probe. Ascent and descent records for each flight show close agreement and values of electron density scaled from $h'(f)$ records agree fairly well with those obtained from rocket measurements.

551.510.535 : 621.3.087.4 **1851**

Vertical Incident Doppler Ionogram.—T. Ogawa, S. Ando & A. Yoshida. (*Proc. Inst. Radio Engrs*, March 1961, Vol. 49, No. 3, p. 643.) An improved apparatus has been constructed for the measurement of Doppler shifts produced by vertical movements of the ionosphere.

551.510.535 : 621.3.087.4 **1852**

Contribution to an Investigation of Ionospheric Absorption on a Fixed Frequency.—G. Pillet. (*Ann. Télécommun.*, July/Aug. & Sept./Oct. 1960, Vol. 15, Nos. 7/8 & 9/10, pp. 157–184 & 198–219.) A thesis, concerning theoretical and experi-

mental aspects of ionospheric absorption measurements by vertical-incidence sounding. Measurements made on a frequency of 3·4 Mc/s during the period September 1955–March 1958 are analysed. 74 references.

551.510.535: 621.391.812.63 **1853**

Determination of Ionospheric Absorption from Recordings of Field Strength and Cosmic Noise.—H. Schwentek. (*Arch. tech. Messen*, Sept. 1960, No. 296, pp. 177–180.) Brief descriptions are given of a method of determining the ionospheric absorption index from oblique incidence recordings (see also 2732 of 1959), and of the riometer method using extraterrestrial noise sources [1566 of 1959 (Little & Leinbach)].

551.510.535(98): 621.391.812.631 **1854**

Statistical Study in the Occurrence of Polar Blackouts.—I. Kasuya. (*J. Radio Res. Labs, Japan*, Sept. 1960, Vol. 7, No. 33, pp. 451–465.) The distributions of radio blackouts in both hemispheres are examined using f_{min} data at 31 stations in the north and 12 stations in the south. The changes of blackout occurrence and times of maximum occurrence frequency with position are studied.

551.510.536 **1855**

A Theoretical Model of Electron Density Distribution along a Geomagnetic Line of Force in the Exosphere.—R. L. Dowden. (*J. atmos. terr. Phys.*, March 1961, Vol. 20, Nos. 2/3, pp. 122–130.) A model of electron density in the exosphere is set up by supposing electrons to diffuse along tubes of force. Electron densities in ionosphere and exosphere are related by steady-state solutions. The particle source is in the ionosphere under normal conditions, but during a magnetic storm particles are injected into a tube of force at its furthest point from earth. The role of collisions is discussed.

551.594.5: 621.396.96 **1856**

A Note on the Disposition of Daytime Auroral Ionization in Space.—R. L. Leadabrand. (*J. geophys. Res.*, Feb. 1961, Vol. 66, No. 2, pp. 421–428.) Radio aurorae are classified into two groups according to latitude spread. The properties are compared and their relation to "diffuse" and "discrete" aurorae is discussed.

551.594.5: 621.396.96 **1857**

The Slant E_s Echo—a High-Frequency Auroral Echo.—H. F. Bates. (*J. geophys. Res.*, Feb. 1961, Vol. 66, No. 2, pp. 447–454.) The slant E_s echo is associated with v.h.f. auroral echoes. It is formed by scattering from randomly distributed field-aligned irregularities and is enhanced by least-time focusing and aspect focusing.

551.594.5: 621.396.96 **1858**

Temporal Variations of Auroral Radio-Echo Activity in Subauroral Latitudes.—C. D. Watkins. (*J. atmos. terr. Phys.*, March 1961, Vol. 20, Nos. 2/3, pp. 140–148.) The diurnal, 27-day, seasonal and 11-year variations in the occurrence of radio aurorae are investigated and also the time delay between class-3 flares and the appearance of aurorae is measured. The bimodal diurnal distribution may be a consequence of the specular reflection properties of the auroral echoes.

551.594.5: 621.396.96: 550.386 **1859**

Auroral Radio Echoes and Magnetic Disturbances.—C. D. Watkins. (*J. atmos. terr. Phys.*, March 1961, Vol. 20, Nos. 2/3, pp. 131–139.) The occurrence of radio echoes from aurora is strongly correlated with local *K*-index. The position and motion of individual echo regions correspond closely with the current systems causing magnetic disturbances.

551.507.362: 061.3 **1860**

Space Research. [Book Review]—H. Kallmann Bijl (Ed.). Publishers: Interscience, New York, 1960, 1195 pp., $24.00. (*J. atmos. terr. Phys.*, March 1961, Vol. 20, Nos. 2/3, p. 222.) Contains the text, mainly in English, of the scientific papers presented at the First International Space Science Symposium, Nice, January 1960.

551.510.535(084) **1861**

An Atlas of Oblique-Incidence Ionograms. [Book Review]—V. Agy, K. Davies & R. Salaman. Distributors: U.S. Department of Commerce, Washington, D.C., $2.25. (*J. Res. nat. Bur. Stand.*, Jan./Feb. 1961, Vol. 65D, No. 1, pp. 35–36.) The atlas is published as NBS Technical Note No. 31 (1959) and contains routine records for the paths: (*a*) Washington–St. Louis, (*b*) Washington–Boulder. A discussion of equipment is given, and seasonal variation, layer formation and disappearance, spread echo, M.U.F. extension and other phenomena are illustrated.

LOCATION AND AIDS TO NAVIGATION

621.396.933 **1862**

A New Assessment of the Gee System.—D. H. R. Archer. (*Brit. Commun. Electronics*, April 1961, Vol. 8, No. 4, pp. 272–275.) Possible applications of the Gee System to long-range navigation and as a basis for a navigation system for areas where the air traffic is dense are discussed in general terms.

621.396.944 **1863**

Reception and Direction Finding of Electromagnetic Waves in Sea-Water.—G. Zichus. (*Telefunken Ztg*, June 1960, Vol. 33, No. 128, pp. 141–150. English summary, pp. 158–159.) V.l.f. wave propagation in sea-water and the limits set to reception by atmospherics and receiver noise at various depths of submersion are discussed. Formulae are derived for the depths at which reception or direction finding is possible, and maximum depths are calculated as a function of transmitter-receiver distance for given transmitter and receiver characteristics.

621.396.96 **1864**

Radar Picture Transmission.—(*Telefunken Ztg*, Sept. 1959, Vol. 32, No. 125, pp. 152–181. English summaries, pp. 208–210.) The following three papers deal with underlying theory including bandwidth compression and the principles of storage-tube design; four such storage tubes are described and details are given of an experimental system.

(*a*) Principles and Fundamental Problems.—F. Schröter (pp. 152–161).

(*b*) Storage Tubes.—J. E. Otto & W. Schaffernicht (pp. 162–173).

(*c*) Frequency-Band Compression of Radar Signals by means of a Line Storage Tube with Circular Deflection of the Electron Beam.—K. Dinter (pp. 174–181).

621.396.96 **1865**

Technique for Amplitude Modulating a Van Atta Radar Reflector.—L. H. Bauer. (*Proc. Inst. Radio Engrs*, March 1961, Vol. 49, No. 3, pp. 634–635.) By introducing phase shifts in the interconnecting lines of a Van Atta array, the radar return can be modulated in amplitude electronically.

621.396.963.3 **1866**

Combining Remote Radars on a Central Display.—G. E. Martin. (*Electronics*, 17th Feb. 1961, Vol. 34, No. 7, pp. 124–125.) Each radar is represented by its own separate sweep on the combined p.p.i. display.

621.396.963.3: 621.385.832 **1867**

Practical Tubes for Bright Radar Displays.—Veith. (See 2054.)

621.396.969.3 **1868**

Techniques and Problems of Tracking Radar.—A. F. Braun. (*Bull. schweiz. elektrotech. Ver.*, 16th July 1960, Vol. 51, No. 14, pp. 689–700.) The operating principles of various types of radar are summarized. Problems relating to system and equipment design and to operation under various conditions are discussed.

621.396.969.3 **1869**

Automatic Beacon Radar Identifies Aircraft.—W. L. Woodson. (*Electronics*, 10th Feb. 1961, Vol. 34, No. 6, pp. 57–61.) An automatic aircraft interrogation system using airborne transponders is described.

621.396.969.3 **1870**

A Radar Observation of a Sea-Breeze Front.—E. Eastwood & G. C. Rider. (*Nature, Lond.*, 25th March 1961, Vol. 189, No. 4769, pp. 978–980.) The length and penetration inland of a sea-breeze front have been studied using a 23-cm radar and a photographic time-compression technique. It is probable that both birds and refractive discontinuities contributed to mark the passage of the front.

MATERIALS AND SUBSIDIARY TECHNIQUES

535.215: 537.311.33 **1871**

Determination of Recombination Constants from the Spectral Characteristic of a Photocell with a *p-n* Junction.—V. K. Subashiev. (*Fiz. Tverdogo Tela*, Feb. 1960, Vol. 2, No. 2, pp. 205–212.)

535.215: 546.4'682'221 **1872**

Photoconductivity in Ternary Sulphides.—J. A. Beun, R. Nitsche & M.

Lichtensteiger. (*Physica*, Aug. 1960, Vol. 26, No. 8, pp. 647–649.) Measurements in $ZnInS_4$, $CdIn_2S_4$ and $HgInS_4$ are reported.

535.215: 546.47'221 **1873**

The Photovoltaic Effect in Striated ZnS Single Crystals.—W. J. Merz. (*Helv. phys. Acta*, 31st Oct. 1958, Vol. 31, No. 6, pp. 625–635.) The photovoltaic effect was investigated as a function of wavelength, light intensity and temperature. A band model is proposed which provides a qualitative explanation of experimental results.

535.215: 546.48'221 **1874**

Processes Prior to Electrical Breakdown in CdS Single Crystals.—K. W. Böer & U. Kümmel. (*Z. angew. Phys.*, June 1960, Vol. 12, No. 6, pp. 241–244.) The various stages of breakdown due to thermal effects and high field strengths are discussed and illustrated by photographs obtained with the aid of electro-optical techniques [1636 of 1960 (Böer et al.)].

535.215: 546.48'221 **1875**

A Contribution to the Clarification of the Spectral Distribution of the Photoconductivity of CdS Single Crystals.—H. Berger, K. W. Böer & E. H. Weber. (*Mber. dtsch. Akad. Wiss. Berlin*, 1960, Vol. 2, No. 2, pp. 95–101.) An interpretation is given of the results of photoconductivity measurements in the region of the absorption edge at room temperature, in which three maxima are usually obtained. See also 1904 of 1959 (Böer & Gutjahr).

535.215: 546.48'221 **1876**

Anomalous Photovoltaic Effect of CdS Single Crystals.—S. Ibuki, H. Komiya & H. Yamashita. (*J. phys. Soc. Japan*, Dec. 1960, Vol. 15, No. 12, p. 2356.) Photovoltaic effects observed in a CdS crystal partly coated with an evaporated Cu layer are explained as a combination of *p-n* junction action and electron diffusion.

535.215; 546.48'221: 539.23 **1877**

Effect of Oxygen upon Sintered Cadmium Sulphide Photoconducting Films.—S. Kitamura. (*J. phys. Soc. Japan*, Dec. 1960, Vol. 15, No. 12, pp. 2343–2350.)

535.215: 546.682'86 **1878**

Photosensitivity Spectrum Distribution of *p*-Type Indium Antimonide.—D. N. Nasledov, M. P. Pronina & Yu. S. Smetannikova. (*Fiz. Tverdogo Tela*, Feb. 1960, Vol. 2, No. 2, pp. 239–241.) A note of measurements of photoconductivity and photomagnetic effect in *p*-type samples with acceptor concentrations from 10^{13} to 10^{15}/cm^3.

535.215: 546.817'221 **1879**

On the Temperature Dependence of the Photoconductive Decay Time of Films of the Lead Salts.—F. M. Klaassen, J. Blok, H. C. Booy & F. J. De Hoog. (*Physica*, Aug. 1960, Vol. 26, No. 8, pp. 623–628.) A comparison of theory with results of measurements on PbS photodetectors indicates that minority carriers are retrapped repeatedly before recombination occurs.

535.37: 537.311.3 **1880**

The Relation between the Recombination Luminescence and Conductivity under Nonisothermal Conditions.—K. K. Rebane. (*Fiz. Tverdogo Tela*, Feb. 1960, Vol. 2, No. 2, pp. 273–274.)

535.37: 546.47'221 **1881**

Electronic Structure of the Centres in ZnS.—J. L. Birman. (*Phys. Rev.*, 1st Jan. 1961, Vol. 121, No. 1, pp. 144–145.)

535.37: 546.47'221 **1882**

Vapour-Phase Growth and Properties of Zinc Sulphide Single Crystals.—H. Samelson. (*J. appl. Phys.*, Feb. 1961, Vol. 32, No. 2, pp. 309–317.)

535.376 **1883**

Surface Recombination and Diffusion Processes in Cathodoluminescence and Electron-Bombardment-Induced Conductivity.—G. Gergely. (*J. Phys. Chem. Solids*, Dec. 1960, Vol. 17, Nos. 1/2, pp. 112–116.) Values of diffusion length and surface recombination velocity are obtained from an analysis of experimental brightness/voltage curves.

535.376: 546.47'221 **1884**

Electroluminescence of Zinc Sulphide Single Crystals.—I. T. Steinberger, V. Bar & E. Alexander. (*Phys. Rev.*, 1st Jan. 1961, Vol. 121, No. 1, pp. 118–124.) Rectangular voltage pulses were applied to single crystals of ZnS. During the 'on' period the emission gradually increased to a stationary level. Removal of the voltage resulted in a burst of emission which decayed slowly. A model is suggested which explains this behaviour.

535.376: 546.48'221 **1885**

Electroluminescence of CdS Single Crystal.—H. Yamashita, S. Ibuki, M. Yoshizawa & H. Komiya. (*J. phys. Soc. Japan*, Dec. 1960, Vol. 15, No. 12, p. 2366.) Description and possible explanation of electroluminescence observations.

535.376: 546.681'18 **1886**

Electroluminescence of Gallium Phosphide Crystals.—F. G. Ullman. (*Nature, Lond.*, 8th April 1961, Vol. 190, No. 4771, pp. 161–162.) Results obtained with crystals of GaP weakly doped with Zn corroborate the observations of Wolff et al. (1433 of 1956).

537.227 **1887**

Thermal Conduction in Ferroelectric Ceramics.—I. Yoshida. (*J. phys. Soc. Japan*, Dec. 1960, Vol. 15, No. 12, pp. 2211–2219.) Measurements on Pb, Ba and Sr titanates and on Pb zirconate are described and discussed in relation to crystal structure.

537.227: 546.431'824-31 **1888**

On the Origin of Barkhausen Pulses in $BaTiO_3$.—R. C. Miller. (*J. Phys. Chem. Solids*, Dec. 1960, Vol. 17, Nos. 1/2, pp. 93–100.) The domain phenomena which give rise to ferroelectric Barkhausen pulses in $BaTiO_3$ have been investigated experimentally; specific domain phenomena have been correlated with particular Barkhausen pulse shapes.

537.227: 621.318.57 **1889**

The Reversal of the Spontaneous Polarization in Guanidine Aluminium Sulphate Hexahydrate.—E. Fatuzzo. (*Helv. phys. Acta*, 15th Aug. 1960, Vol. 33, No. 5, pp. 429–436.) Crystals have been subjected to electrical and thermal treatment and their switching properties studied under different conditions. These properties may, with some additional assumptions, be described by the model developed by Fatuzzo & Merz (1267 of 1960) for triglycine sulphate. At high electric fields the domain-wall motion time is longer than the nucleation time and hence controls the switching process.

537.311.3: 538.21 **1890**

The Relation between Magnetism and Electrical Conductivity of Compounds with Transition Elements.—F. Hulliger. (*Helv. phys. Acta*, 31st Dec. 1959, Vol. 32, Nos. 6/7, pp. 615–654. In German.) A detailed review and discussion of theoretical and experimental results. Over 100 references.

537.311.31: 538.63 **1891**

Transverse-Even Voltage: a High-Field Galvanomagnetic Effect associated with Open Orbits in Metals.—J. R. Klauder & J. E. Kunzler. (*Phys. Rev. Lett.*, 15th Feb. 1961, Vol. 6, No. 4, pp. 179–182.) The shape of the Fermi surface and the open orbit directions can be determined by measurements in single copper crystals of even voltages transverse to the current, when H is also transverse.

537.311.33 + 535.215 **1892**

Carrier Density Fluctuations in Semiconductors and Photoconductors with One Kind of Trapping Centres.—F. M. Klaassen, K. M. Van Vliet & J. Blok. (*Physica*, Aug. 1960, Vol. 26, No. 8, pp. 605–617.) Expressions for the matrix elements of carrier density fluctuations and for relaxation times are given.

537.311.33 **1893**

Volume-Controlled, Two-Carrier Currents in Solids: the Injected Plasma Case.—M. A. Lampert & A. Rose. (*Phys. Rev.*, 1st Jan. 1961, Vol. 121, No. 1, pp. 26–37.) Double injection into semiconductors and insulators is studied under conditions where the injected electrons and holes are free. The current is field-driven and volume-controlled. The analysis shows an extended voltage region following the Ohm's law region, over which the current is proportional to the voltage squared. In this region the current is depressed through the increase in the number of minority carriers in thermal equilibrium. This is shown to result from recombination kinetics.

537.311.33 **1894**

Hydrogen-Like Impurity States in Axially Symmetric Crystals.—R. W. Keyes. (*IBM J. Res. Develpm.*, Jan. 1961, Vol. 5, No. 1, pp. 65–66.)

537.311.33 **1895**

Influence of Intercarrier Collisions on Hall Mobility in Singular Semiconductors.—Y. Uchiyama. (*Progr. theor. Phys.*, Aug. 1960, Vol. 24, No. 2, pp. 433–

456.) The correction due to the inter-electronic collision is found to be very small in magnitude.

537.311.33 **1896**

Structure of the Energy Bands in Semiconductors of the $CdIn_2Se_4$ Type.—A. I. Gubanov & F. M. Gashimzade. (*Fiz. Tverdogo Tela*, Feb. 1960, Vol. 2, No. 2, pp. 255–260.)

537.311.33 **1897**

Semiconduction in $Li_xNi_{(1-x)}O$.—S. van Houten. (*J. Phys. Chem. Solids*, Dec. 1960, Vol. 17, Nos. 1/2, pp. 7–17.) NiO is an insulator, which may be made conducting by the addition of LiO. An energy level scheme which explains this behaviour is discussed.

537.311.33 **1898**

Current Voltage Characteristics of Forward-Biased Long *p-i-n* Structures.—R. D. Larrabee. (*Phys. Rev.*, 1st Jan. 1961, Vol. 121, No. 1, pp. 37–39.) The characteristics have been observed in several Ge *p-i-n* structures in which the *n* side was biased negatively and the *p* side positively so as to cause a double injection of electrons and holes.

537.311.33: 53.082.7 **1899**

Thermoelectrically Cooled Probe for the Determination of Semiconductor Type.—R. V. Jeanes & K. E. G. Pitt. (*J. sci. Instrum.*, Jan. 1961, Vol. 38, No. 1, p. 33.) A simple Bi_2Te_3 cold-probe device is described for the determination of semiconductor type in a near-intrinsic Ge sample. Because the probe is at a lower temperature than the sample there is no risk of heat transfer and subsequent type inversion typical of the hot-probe method.

537.311.33: 535.215 **1900**

Bulk Photoeffects in Inhomogeneous Semiconductors.—C. D. Cox. (*Canad. J. Phys.*, Oct. 1960, Vol. 38, No. 10, pp. 1328–1342.) Theoretical expressions are derived for the relation between photo-e.m.f. and illumination, and between photo-e.m.f. and resistance decrease. Experimental results for Ge filaments are given.

537.311.33: 537.312.9 **1901**

Effect of High Pressure on Electrical Properties of NiO, CoO, CuO and Cu_2O.—A. P. Young, W. B. Wilson & C. M. Schwartz. (*Phys. Rev.*, 1st Jan. 1961, Vol. 121, No. 1, pp. 77–82.)

537.311.33: 537.32 **1902**

Thermoelectric Behaviour of *p-n* Junctions.—M. Cutler. (*J. appl. Phys.*, Feb. 1961, Vol. 32, No. 2, pp. 222–227.) Equations are derived for the flow of carriers and electronic heat when a temperature difference and a potential difference exist across a *p-n* junction. Large- and small-signal situations are discussed.

537.311.33: 538.569.4 **1903**

A Note on Date's Paper 'Magnetoplasma Resonance in Semiconductors: Part I'.—K. Yamagata. (*J. phys. Soc. Japan*, Dec. 1960, Vol. 15, No. 12, p. 2363.) Comment on 930 of March considering the effect of anisotropic mass on magneto-plasma resonance.

537.311.33: 538.63 **1904**

Galvanomagnetic Effects and their Application.—C. Hilsum. (*Brit. J. appl. Phys.*, March 1961, Vol. 12, No. 3, pp. 85–91.) The properties of semiconductors suitable for galvanomagnetic applications are discussed and instruments based on the Hall effect and magnetoresistance are described.

537.311.33: 546.23 **1905**

Dielectric Investigations of Polycrystalline Selenium.—W. Ludwig. (*Mber. dtsch. Akad. Wiss. Berlin*, 1960, Vol. 2, No. 2, pp. 91–92.) Brief note on results of a.c. bridge measurements on Br-doped high-purity Se at temperatures in the range $+40°$ to $-160°$C.

537.311.33: [546.28 + 546.289 **1906**

The Temperature Dependence of the Polarizability of the Free Carriers in Germanium and Silicon.—M. Cardona, W. Paul & H. Brooks. (*Helv. phys. Acta*, 15th Aug. 1960, Vol. 33, No. 5, pp. 329–346.) The contribution of the free carriers to the total electric polarizability was determined from the reflectivity and an average effective mass for the carriers was deduced. An increase in electron mass with both carrier concentration and temperature was found in both *n*-type Ge and *n*-type Si. No definite conclusions could be drawn about *p*-type Ge owing to transitions between branches of the degenerate valence band. For *p*-type Si the effective mass increases with temperature.

537.311.33: [546.28 + 546.289 **1907**

Theory of Solubility of Interstitial Impurities in Germanium and Silicon.—K. Weiser. (*J. Phys. Chem. Solids*, Dec. 1960, Vol. 17, Nos. 1/2, pp. 149–161.) A theory of solubility is developed which is based on estimating the change in energy and in entropy when an impurity is placed in an interstitial site in the lattice.

537.311.33: [546.28 + 546.289] : 535.215 **1908**

Photoelectron Emission from Germanium and Silicon in the Amorphous and Crystalline States.—P. G. Borzyak, L. S. Miroshnichenko & O. G. Sarbei. (*Fiz. Tverdogo Tela*, Feb. 1960, Vol. 2, No. 2, pp. 314–318.) The spectral sensitivity curve for crystalline Ge shows a dip in the short-wavelength region which is not observed with amorphous films. This effect is less marked in the case of Si.

537.311.33: [546.28 + 546.289] : 539.23 **1909**

The Preparation of Thin Films of Germanium and Silicon.—B. A. Irving. (*Brit. J. appl. Phys.*, March 1961, Vol. 12, No. 3, pp. 92–93.) Films about 1 000 Å thick, suitable for observing dislocations by transmission electron microscopy, have been prepared from the brittle semiconductors germanium and silicon by a combination of mechanical polishing and chemical etching.

537.311.33: 546.28 **1910**

Surface States on Cleaved Silicon.—D. R. Palmer, S. R. Morrison & C. E. Dittenbaugh. (*Phys. Rev. Lett.*, 15th Feb. 1961, Vol. 6, No. 4, pp. 170–173.)

537.311.33: 546.28 **1911**

Acoustic-Mode Mobilities for 'Split *p*-Silicon'.—P. J. Price & Y. H. Kao. (*IBM J. Res. Develpm.*, Jan. 1961, Vol. 5, No. 1, pp. 63–64.)

537.311.33: 546.28 **1912**

Spin Resonance of Electrons on Donors in *p*-type Silicon.—G. Bemski & B. Szymanski. (*J. Phys. Chem. Solids*, Dec. 1960, Vol. 17, Nos. 1/2, pp. 173–175.) The resonance was observed using compensated *p*-type Si crystals after the samples had been illuminated with light of about 1 $\mu\lambda$. The amplitude of the resonance gives useful information on the concentration of the donor.

537.311.33: 546.28 **1913**

The Effect of Gold on the Electrical Properties of Silicon.—B. I. Boltaks, G. S. Kulikov & R. Sh. Malkovich. (*Fiz. Tverdogo Tela*, Feb. 1960, Vol. 2, No. 2, pp. 181–191.) Donor and acceptor levels determined from Hall-effect measurements agree with those reported by Collins et al. (2498 of 1957). Experimental and calculated values of resistivity and carrier concentration in gold-alloyed samples of *n*- and *p*-type Si with different initial resistivity are compared. A nomogram for calculating the resistance of gold-alloyed samples is given.

537.311.33: 546.28: 535.34-15 **1914**

The Absorption of Infrared Radiation by Free Charge Carriers in Silicon.—V. S. Vavilov. (*Fiz. Tverdogo Tela*, Feb. 1960, Vol. 2, No. 2, pp. 374–377.) Measurements have been made in the wavelength range 1–11 μ on single-crystal *p*- and *n*-type Si with carrier concentration between 10^{16} and 5×10^{17} cm^{-3}, and on samples with carrier concentration 10^{19} cm^{-3} irradiated with fast neutrons. For highly transparent crystals the $\lambda^{3.5}$ relation for the absorption coefficient was not confirmed.

537.311.33: 546.289 **1915**

Pressure Dependence of the Direct Energy Gap in Germanium.—M. Cardona & W. Paul. (*J. Phys. Chem. Solids*, Dec. 1960, Vol. 17, Nos. 1/2, pp. 138–142.) "The pressure dependence of the energy gap corresponding to allowed optical transitions in Ge has been measured at room temperature and pressures up to 7 000 kg/cm^2. This direct energy gap is found to increase at a rate of $1{\cdot}3 \pm 0{\cdot}1 \times 10^{-5}$ eV.cm^2/kg, in agreement with previous approximate determinations and with the pressure coefficient of the same energy gap in group III-V compounds."

537.311.33: 546.289 **1916**

Direct Viewing of Imperfections in Germanium *p-n* Junctions.—M. Tomono. (*J. phys. Soc. Japan*, Dec. 1960, Vol. 15, No. 12, pp. 2254–2264.) A copper-plating method is described for making junction imperfections visible. The imperfections are then related to the reverse (electrical) characteristics of the junction.

537.311.33: 546.289 **1917**

Investigation of the Effect of Certain Factors on Formation of Dislocations during Crystallization and on the Dislocation Status in Germanium Single-

Crystals.—A. D. Belyaev, V. N. Vasilevskaya & E. G. Miselyuk. (*Fiz. Tverdogo Tela*, Feb. 1960, Vol. 2, No. 2, pp. 227–234.) Dislocations dispersed between boundaries of regions with different orientation are displaced toward these boundaries by annealing at 700–800 °C. Dislocations at these boundaries are removed only at temperatures close to the melting point. The effect of dislocations of density from 10^6 to 10^7/cm² on carrier lifetime is determined.

537.311.33: 546.289 **1918**

The Effect of Lead Treatment of Germanium on the Lifetime of Non-equilibrium Charge Carriers.—A. S. Medkikov. (*Fiz. Tverdogo Tela*, Feb. 1960, Vol. 2, No. 2, pp. 235–238.) The diffusion length of minority carriers substantially decreased with the removal of residual Cu from Ge by treatment with molten lead. Increasing the Cu concentration caused the diffusion length first to increase and then to decrease.

537.311.33: 546.289 **1919**

Electron-Electron Interaction in Hot-Electron Problems.—J. Yamashita. (*Progr. theor. Phys.*, Aug. 1960, Vol. 24, No. 2, pp. 357–369.) The theory of warm and hot electrons in *n*-type Ge at 77 °K is discussed with reference to Gunn's experiments (*J. Phys. Chem. Solids*, Jan. 1959, Vol. 8, pp. 239–241).

537.311.33: 546.289 **1920**

Donor Concentration at the Surface of a Diffused *n*-Type Layer on *p*-Type Germanium.—R. Glang & W. B. Easton. (*J. electrochem. Soc.*, Sept. 1960, Vol. 107, No. 9, pp. 758–763.) Four methods of evaluating donor concentration have been investigated. All methods assume a complementary error function distribution in the diffused layer and require the use of experimental and published data. With three of the methods calculated surface concentrations agree within a factor of 2 or 3.

537.311.33: 546.289: 535.215 **1921**

Current/Voltage Characteristics of Photoelectric Emission from Germanium.—P. G. Borzyak, P. M. Marchuk & O. G. Sarbei. (*Fiz. Tverdogo Tela*, Feb. 1960, Vol. 2, No. 2, pp. 306–313.) Experimentally determined I/V characteristics of the emission from Ge films with low work function show no evidence of a bulk photoeffect.

537.311.33: 546.3-1'289'28 **1922**

Electrical Conductivity and Hall Effect of Ge-Si Alloys.—G. Busch & O. Vogt. (*Helv. phys. Acta*, 15th Aug. 1960, Vol. 33, No. 5, pp. 437–458. In German.) Methods of preparation of Ge-Si single-crystal and polycrystalline alloys are described. Hall coefficients and conductivity have been measured in the temperature range 20°–900 °C, and electron and hole mobilities and intrinsic carrier concentrations calculated as functions of alloy composition. Typical results are given and discussed.

537.311.33: 546.3-1'289'28 **1923**

Indirect Transition in Narrow Junction of Ge-Si Alloy.—K. Ando. (*J. phys. Soc. Japan*, Dec. 1960, Vol. 15, No. 12, p. 2360.) Data on indirect transitions are obtained from cusps in junction characteristics measured at liquid helium temperature.

537.311.33: [546.571'221 + 546.55'231 **1924**

Relations between the Crystalline Structure and the Electronic Properties of Ag_2S, Ag_2Se, Cu_2Se Compounds.—P. Junod. (*Helv. phys. Acta*, 31st Dec. 1959, Vol. 32, Nos. 6/7, pp. 567–600. In French.)

537.311.33 ([546.571'221 + 546.571'231 **1925**

Brillouin Zones, Chemical Bonds and Conduction Mode of Ag_2S and Ag_2Se.—P. Junod. (*Helv. phys. Acta*, 31st Dec. 1959, Vol. 32, Nos. 6/7, pp. 601–614. In French.)

537.311.33: 546.681'19 **1926**

Scattering of Current Carriers in Gallium Arsenide in the Presence of Strong Degeneracy.—O. V. Emel'yanenko, T. S. Lagunova & D. N. Nasledov. (*Fiz. Tverdogo Tela*, Feb. 1960, Vol. 2, No. 2, pp. 192–197.) Results of conductivity and Hall-effect measurements on GaAs samples with *n*- and *p*-type impurity conductivity show that the mobility of electrons and holes depends only weakly on the concentration of uncompensated impurities.

537.311.33: 546.681'682'19 **1927**

Electrical and Optical Properties of GaAs-InAs Alloys.—J. C. Woolley, C. M. Gillett & J. A. Evans. (*Proc. phys. Soc.*, 1st March 1961, Vol. 77, No. 495, pp. 700–704.) Electrical measurements showed that there is mixed conduction in the alloys and hence the Hall mobility is without significance. Optical transmission measurements of optical energy gap give good agreement with values obtained by diffuse-reflection methods.

537.311.33: 546.681'682'86 **1928**

Electrical Properties of GaSb-InSb Alloys.—J. C. Woolley & C. M. Gillett. (*J. Phys. Chem. Solids*, Dec. 1960, Vol. 17, Nos. 1/2, pp. 34–43.) The electrical properties have been investigated as a function of composition. Values of extrapolated thermal energy gap, electron mobility and mobility ratio have been determined for some 25 specimens.

537.311.33: 546.682'86 **1929**

Orientation-Dependent Distribution Coefficients in Melt-Grown InSb Crystals.—J. B. Mullin & K. F. Hulme. (*J. Phys. Chem. Solids*, Dec. 1960, Vol. 17, Nos. 1/2, pp. 1–6.)

537.311.33: 546.682'86 **1930**

Carrier Lifetime in Indium Antimonide.—R. A. Laff & H. Y. Fan. (*Phys. Rev.*, 1st Jan. 1961, Vol. 121, No. 1, pp. 53–62.) The recombination of excess electron-hole pairs in InSb has been studied in the temperature range 200 °K–15 °K where it is controlled by localized centres. A model for the process is deduced from the analysis of the results, and evidence is obtained that the recombination centres are due to structural defects.

537.311.33: 546.682'86: 538.63 **1931**

Galvanomagnetic Effects in Three-Band Semiconductors—Experiments with *p*-Type InSb.—G. Fischer. (*Helv. phys. Acta*, 15th Aug. 1960, Vol. 33, No. 5, pp. 403–488.) A three-band model is discussed and formulae are given with which it is possible to derive values for the concentrations and mobilities of the various charge carriers from the dependence of the Hall coefficient and resistivity on the magnetic field. This model appears valid for *p*-type InSb in the extrinsic range.

537.311.33: 546.817'281: 538.63 **1932**

Oscillatory Magnetoresistance in *n*-Type PbTe.—C. D. Kuglin, M. R. Ellett & R. F. Luff. (*Phys. Rev. Lett.*, 15th Feb. 1961, Vol. 6, No. 4, pp. 177–179.)

537.312.62 **1933**

Magnetic-Field Dependence of Energy Gap in Superconductors.—A. A. Gupta & V. S. Mathur. (*Phys. Rev.*, 1st Jan. 1961, Vol. 121, No. 1, pp. 107–117.) The dependence of the energy gap on static magnetic fields has been derived in a gauge-invariant way from the theory of Bardeen et al. (1386 of 1958). The gap decreases with magnetic field approaching the critical value. Optimum conditions for observation of this effect are discussed.

537.312.62: 538.63 **1934**

Superconductivity in Nb_3Sn at High Current Density in a Magnetic Field of 88 kG.—J. E. Kunzler, E. Buehler, F. S. L. Hsu & J. H. Wernick. (*Phys. Rev. Lett.*, 1st Feb. 1961, Vol. 6, No. 3, pp. 89–91.) Results of observations indicate that superconducting solenoid magnets with fields of 100 kG are feasible.

538.1/.2: 061.3 **1935**

International Colloquium on Magnetism.—(*J. Phys. Radium*, Feb./March 1959, Vol. 20, Nos. 2/3, pp. 65–442.) The text is given of papers presented and subsequent discussions at the colloquium held in Grenoble, 2nd–6th July 1958. 78 papers were presented of which 44 were in English.

538.22: 537.27 **1936**

Magnetoelectric Effect in Antiferromagnetics.—D. N. Astrov. (*Zh. eksp. teor. Fiz.*, March 1960, Vol. 38, No. 3, pp. 984–985.) A note on measurements of the magnetic moment developed in a sample of Cr_2O_3 in an alternating electric field. Curves show the temperature dependence of a signal at the output of a measuring amplifier with fields of 230 and 430 V/cm at 10^4 c/s.

538.221 **1937**

Anisotropy on Polycrystalline Sheets of V-Permendur.—C. Kuroda. (*J. phys. Soc. Japan*, Dec. 1960, Vol. 15, No. 12, p. 2355.)

538.221 **1938**

The Anisotropy Constants of Ferromagnetic Cubic Crystals.—A. S. Viglin. (*Fiz. Tverdogo Tela*, Feb. 1960, Vol. 2, No. 2, pp. 331–346.) Numerical treatment relating to calculations of anisotropy energy.

538.221 **1939**

On the Mechanism of Reversible Appearance of Residual Magnetization at Low Temperature Transition in

a Ge-Gr. —K. Strnat, A. Ewing & G. Hoffer. (*J. phys. Soc. Japan*, Dec. 1960, Vol. 15, No. 12, pp. 2357–2358.)

538.221 : 539.23 **1940**

Digital Representation of the Coherent Rotation of Magnetization in Thin Ferromagnetic Films.—R. Feldtkeller. (*Z. angew. Phys.*, June 1960, Vol. 12, No. 6, pp. 257–261.) Details of the magnetic reversal process in thin films are discussed and a graphical method is given for determining the direction and rate of change of magnetization at any instant on the basis of the directional characteristics of magnetization energy.

538.221 : 539.23 : 537.311.9 **1941**

Influence of a Magnetic Field on the Electrical Resistance of Thin Ferromagnetic Layers at Low Temperatures.—A. B. Sliwin. (*Physica*, July 1959, Vol. 25, No. 7, pp. 501–509.)

538.221 : 621.318.124 **1942**

The Thermomagnetic Behaviour of Cobalt Ferrite.—L. F. Bates & A. J. Parry. (*Proc. phys. Soc.*, 1st March 1961, Vol. 77, No. 495, pp. 167–175.) The behaviour is similar to that of other materials; a new method of analysis of results is described.

538.221 : 621.318.134 **1943**

Low-Loss Ferrites used in Electronics and Telecommunications.—Y. Leycuras & A. Pierrot. (*Câbles & Transm.*, July 1960, Vol. 14, No. 3, pp. 220–244.) The effects of manufacturing procedure and, in particular, conditions of heat treatment on the permeability and loss factors of Mn-Zn and Ni-Zn ferrites are investigated.

538.221 : 621.318.134 **1944**

Manganese-Zinc Ferrites with Spontaneous Isoperm Loop.—M. Kornetzki, E. Moser & E. Röss. (*Naturwissenschaften*, June 1960, Vol. 47, No. 12, p. 274.) The magnetization curve of a magnetically isotropic ferrite of composition $Mn_{0\cdot46}Zn_{0\cdot47}Fe_{0\cdot07}O.Fe_2O_3$ is given; the probable causes of the isoperm characteristic are discussed.

538.221 : 621.318.134 **1945**

Spontaneous Magnetization of Magnesium Ferrite-Manganite System.—K. Muramori & S. Miyahara. (*J. phys. Soc. Japan*, Dec. 1960, Vol. 15, No. 12, p. 2354.)

538.221 : 621.318.134 **1946**

Interpretation of the Characteristics of Microwave Ferrites by means of the Forced Precession of Gyroscopes.—H. Lueg. (*Telefunken Ztg*, June 1960, Vol. 33, No. 128, pp. 132–140. English summary, p. 158.) The use of a gyroscope is proposed as an analogue of the gyromagnetic properties of ferrites. The validity of the method is checked using results of ferrite measurements by other authors.

538.221 : 621.318.134 **1947**

The Irreversible Change of Magnetization produced in 'Square-Loop' Ferrite by Pulsed Magnetic Fields.—J. E. Knowles. (*Proc. phys. Soc.*, 1st March 1961, Vol. 77, No. 495, pp. 576–586.) The experimental results were interpreted in terms of a domain-wall model; it was found that the dissipated energy passed through a maximum 25 times in the course of a magnetization reversal.

538.221 : 621.318.134 : 538.569.4 **1948**

Note on Ferromagnetic Relaxation Equations.—H. Suhl & R. C. Fletcher. (*J. appl. Phys.*, Feb. 1961, Vol. 32, No. 2, pp. 281–282.) The omission of an explicit back-reaction term in 'energy' and 'number of quanta' formulations is justified provided a large number of spin waves are excited by the scattering centres.

538.221 : 621.318.134 : 538.569.4 **1949**

Suppression of Subsidiary Absorption Fronton by Modulation Techniques.—C. G. Hartwick, E. H. Pressnall & W. E. Weiss. (*Phys. Rev. Lett.*, 15th Feb. 1961, Vol. 6, No. 4, pp. 170–177.) The prediction of Suhl (1957 above) is confirmed by experiments on Y-Fe garnet. Optimum modulation frequencies of about 1 Mc/s are found, depending upon the excess of the microwave field above normal threshold.

538.221 : 621.318.134 : 538.569.4 **1950**

Ferrimagnetic Resonance in Ferroxplana from Garnet.—T. Miyadai. (*J. phys. Soc. Japan*, Dec. 1960, Vol. 15, No. 12, pp. 2305–2310.) Study of g-values and line widths of single-crystal and polycrystalline specimens at 18 Gc/s and at temperatures from 100 °K to the Curie point (565 °K).

538.222 : 534.283-8 **1951**

Selection Rule for the Interaction of Microwave Ultrasonics with Spins.—N. S. Shiren & E. B. Tucker. (*Phys. Rev. Lett.*, 1st Feb., 1961, Vol. 6, No. 3, pp. 105–106.)

538.222 : 534.283-8 **1952**

Attenuation of Longitudinal Ultrasonic Vibrations by Spin-Phonon Coupling in Ruby.—E. B. Tucker. (*Phys. Rev. Lett.*, 15th Feb. 1961, Vol. 6, No. 4, pp. 183–185.) The magnetoelastic coupling constant is determined from the observed attenuation. See 1951 above.

538.222 : 538.569.4 **1953**

Spin-Lattice Relaxation in Chromium Corundum.—A. A. Manenkov & A. M. Prokhorov. (*Zh. eksp. teor. Fiz.*, March 1960, Vol. 38, No. 3, pp. 729–733.)

538.222 : 538.569.4 **1954**

Relaxation in Ruby.—R. A. Armstrong & A. Szabo. (*Canad. J. Phys.*, Oct. 1960, Vol. 38, No. 10, pp. 1304–1317.) The relaxation of the $(1 \leftrightarrow 2)$ and $(2 \leftrightarrow 3)$ transitions in chrome-doped Al_2O_3 (0·015%) has been studied at S-band frequencies, using a pulsed microwave method, over a range of crystal orientations in the magnetic field at temperatures of 77 °K to 50 °K, and at 4·2 °K and 1·6 °K.

621.315.6 : 538.569.3 **1955**

Electromagnetic Properties of Insulators: Part 2.—V. Ambegaokar. (*Phys. Rev.*, 1st Jan. 1961, Vol. 121, No. 1, pp. 91–103.) The system considered is an insulator plus one electron. The main result is that the response of the system to low-frequency electric fields is exactly that of a free electron with a certain effective mass moving in a medium having the dielectric constant of a perfect insulator. (Part 1: 2468 of 1960 (Ambegaokar & Kohn).)

621.313.33 : 539.23 **1956**

Tunnelling through Thin Insulating Layers.—J. C. Fisher & I. Giaever. (*J. appl. Phys.*, Feb. 1961, Vol. 32, No. 2, pp. 172–177.) Measurements of the tunnelling current through thin Al oxide films can be formally explained by a theory of Holm (2835 of 1951) provided an electron mass factor of 1·9 is used.

MEASUREMENTS AND TEST GEAR

621.3.018.41 : 083.74 : **1957**

The Significance of the Time Intervals arranged in Geometric Progression for the Standard-Frequency and Time-Signal Transmission of the Physikalisch-Technische Bundesanstalt via Station DCF 77.—U. Adelsberger. (*Nachrichtentech. Z.*, June 1960, Vol. 13, No. 6, pp. 296–298.) The usefulness of the time intervals of 2 min and 3 h forming the basis of the transmission schedule and their relation to other useful time intervals are discussed. See also 3977 of 1960 (Stinc) and back references.

621.3.018.41 (083.74) **1958**

Characteristics of the Ammonia Beam Maser (AM-1) as an Atomic Frequency Standard at JJY.—Y. Saburi & M. Kobayashi. (*J. Radio Res. Labs, Japan*, Sept. 1960, Vol. 7, No. 33, pp. 425–436.) The construction of the maser and the associated circuit arrangements are described. Comparisons with time signals emitted from WWVH show that the frequency stability is $\pm$ 2 or 3 parts in 10^{10}.

621.317.2 : 538.566.08] + 534.844.1 **1959**

The Upper Limits for the Reverberation Time of Reverberation Chambers for Acoustic and Electromagnetic Waves.—Walther. (See 1716.)

621.317.3.029.64 : 538.632 **1960**

On the Method of Measuring Hall Coefficient at Microwave Frequencies.—K. Yamagata. (*Sci. Rep. Res. Inst. Tohoku Univ.*, Ser. A, June 1960, Vol. 12, No. 3, pp. 235–246.) A theory of the bimodal or dual-mode cavity without initial unbalance is developed.

621.317.3.029.64 : 538.632 **1961**

Measurement of Hall Mobility of Germanium at a Microwave Frequency.—K. Yamagata & T. Fukuroi. (*Sci. Rep. Res. Inst. Tohoku Univ.*, Ser. A, June 1960, Vol. 12, No. 3, pp. 247–251.) The theory of the dual-mode cavity developed by Yamagata (1960 above) is extended to include the case of initial unbalance and a report is given of experiments based on a dual-mode cavity with resistive unbalance. The accuracy of measurement of the Hall mobility is limited by the accuracy with which the microwave power level can be measured.

621.317.412 **1962**

Measurement of Magnetic Susceptibility in Very High Pulsed Fields.—R. Stevenson. (*Rev. sci. Instrum.*, Jan. 1961, Vol. 32, No. 1, pp. 28–31.) The sample is suspended in a nonuniform magnetic field and the force on it when the field changes is measured by a transducer comprising two piezoelectric crystals.

621.317.755: 531.76 **1963**

Zig-Zag Oscilloscope Presentation of Millimicrosecond Accuracy for Microsecond Time Intervals.—E. G. Leger, D. Nyberg, K. Graf & L. Tardif. (*Rev. sci. Instrum.*, Jan. 1961, Vol. 32, No. 1, pp. 57–61.) The zig-zag wave, the trigger pulses and the time marks 2 mμs wide at 50-mμs intervals are derived from a 2-Mc/s crystal-controlled oscillator; six oscilloscopes can be driven simultaneously or in sequence from delayed triggers.

621.317.794 **1964**

Cobalt-Manganese Semiconducting Oxide Bolometers.—A. L. Burkin & I. T. Sheftel'. (*Fiz. Tverdogo Tela*, Feb. 1960, Vol. 2, No. 2, pp. 288–296.) Techniques for the measurement of bolometer characteristics are discussed and the design of three types of bolometer as infrared-sensitive devices is described.

621.317.794.029.64/.66: 537.312.62 **1965**

Superconductors as Quantum Detectors for Microwave and Submillimetre-Wave Radiation.—E. Burstein, D. N. Langenberg & B. N. Taylor. (*Phys. Rev. Lett.*, 1st Feb. 1961, Vol. 6, No. 3, pp. 92–94.) An analysis of low-voltage tunnelling in metal/barrier/superconductor and superconductor/barrier/superconductor structures suggests its application for measuring microwave and submillimetre radiation incident on the barrier region. Limitations due to carrier lifetime are discussed.

OTHER APPLICATIONS OF RADIO AND ELECTRONICS

531.78: 537.311.33: 537.312.9 **1966**

Semiconductor Strain Gauges offer High Sensitivity.—R. E. Talmo. (*Electronics*, 24th Feb. 1961, Vol. 34, No. 8, pp. 43–45.) Single-crystal Si gives a change in resistance 10–100 times greater for a given strain than metallic gauges. See 3230 of 1960 (Geyling & Forst).

531.79: 621.397.331.3 **1967**

An Automatic Particle Counter and Sizer.—H. A. Dell, D. S. Hobbs & M. S. Richards. (*Philips tech. Rev.*, 4th Aug. 1960, Vol. 21, No. 9, pp. 253–267.) Methods used for automatic counting and sizing are discussed and commercial equipment is described in which the sample is photographed and the film examined automatically using a flying-spot scanning system.

534.88 **1968**

Narrow-Beam Echo-Ranger for Fishery and Geological Investigations.—M. J. Tucker & A. R. Stubbs. (*Brit. J. appl. Phys.*, March 1961, Vol. 12, No. 3, pp. 103–110.) A detailed description is given of a 36-kc/s acoustic echo-ranger with a range of 800 yards suitable for fish detection and geological investigation of the sea bed. Typical records are shown and discussed.

621.362: 621.387 **1969**

A New Thermionic Generator.—D. Gabor. (*Nature, Lond.*, 18th March 1961, Vol. 189, No. 4768, pp. 868–872.) The principle of operation of a vacuum diode using argon vapour is described. The main discharge occurs between the emitter and a large-area collector of cellular construction. Ions are supplied to the main discharge space from an auxiliary discharge between a perforated structure and an auxiliary anode. By controlling this auxiliary discharge, direct generation of a.c. is possible. An experimental cost figure of 0·05–0·1 W/A has been achieved.

621.362: 621.387 **1970**

Low-Frequency Oscillations in a Filamentary-Cathode Cesium Diode Converter.—K. P. Luke & F. E. Jamerson. (*J. appl. Phys.*, Feb. 1961, Vol. 32, No. 2, p. 321.) Oscillations at frequencies below 100 kc/s are reported, and waveforms are given. Some of the characteristics correspond to a plasma potential distribution unlike that in high-frequency oscillations.

621.384.611.3 **1971**

The Design and Construction of a 29-MeV Microtron.—D. K. Aitken, F. F. Heymann, R. E. Jennings & P. I. P. Kalmus. (*Proc. phys. Soc.*, 1st March 1961, Vol. 77, No. 495, pp. 769–785.) The microtron has a 20-ton magnet and a pole diameter of 80 in. An extracted electron beam of 10^{-8} A at an energy of 29 MeV can be focussed to a spot about 2 mm in diameter.

621.384.8 **1972**

Microwave Separator for High-Energy Particle Beams.—P. R. Phillips. (*Rev. sci. Instrum.*, Jan. 1961, Vol. 32, No. 1, pp. 13–16.) 150-MeV electrons were deflected $\frac{1}{2}$ in. at the final focus of the analysing magnet, using a TM_{012} rectangular cavity with a Q of 15 000 and maximum power dissipation of 1·3 MW.

621.387.4: 621.383 **1973**

The Measurement of Proton Currents by means of Photosemiconductors and Measurements of Polarization Dependence on Composite Photocathodes.—P. Görlich. (*Mber. dtsch. Akad. Wiss Berlin*, 1960, Vol. 2, No. 2, pp. 67–70.)

621.396.969.14 **1974**

Speed Measurement by means of the Electromagnetic Doppler Effect.—B. Koch. (*Arch. tech. Messen*, June & Aug. 1960, Nos. 293 & 295, pp. 109–112 & 153–156.) Details are given of practical applications, following an outline of the principles underlying Doppler-radar measurement methods. 61 references.

77: 537.2(083.74) **1975**

I.R.E. Standards on Electrostatographic Devices, 1961.—(*Proc. Inst. Radio Engrs*, March 1961, Vol. 49, No. 3, pp. 619–621.) Standard 60 I.R.E. 28.S2 defining terms used.

PROPAGATION OF WAVES

621.391.812.34: 551.507.362.2 **1976**

Observed Field Strength in the Neighbourhood of the Skip Distance.—Yeh & Swenson. (See 1837.)

621.391.812.61 **1977**

Attenuation of Electromagnetic Wave due to Rain with Distorted Raindrops.—T. Oguchi. (*J. Radio Res. Labs, Japan*, Sept. 1960, Vol. 7, No. 33, pp. 467–485.) The scattered field is expressed as a function of the deformation of a drop from spherical shape. The deformation as a function of terminal velocity is known and hence a relation between attenuation and rate of precipitation can be found. Greater attenuation is expected for horizontal polarization.

621.391.812.61.029.65 **1978**

An Analysis of Recent Measurements of the Atmospheric Absorption of Millimetric Radio Waves.—C. W. Tolbert & A. W. Straiton. (*Proc. Inst. Radio Engrs*, March 1961, Vol. 49, No. 3, pp. 649–650.) Water-vapour losses are greatly enhanced near the oxygen absorption lines. See 1813 above.

621.391.812.62.029.62 **1979**

Observation of F-Layer and Sporadic-E Scatter at V.H.F. in the Far East.—K. Miya, T. Sasaki & M. Ishikawa. (*J. Res. nat. Bur. Stand.*, Jan./Feb. 1961, Vol. 65D, No. 1, pp. 93–99.) Describes measurements made over the paths Okinawa-Tokyo (1 480 km) and Philippines-Tokyo (2 850 km) at about 50 Mc/s.

621.391.812.621 **1980**

Correlation of Monthly Median Transmission Loss and Refractive Index Profile Characteristics.—B. R. Bean & B. A. Cahoon. (*J. Res. nat. Bur. Stand.*, Jan.–Feb. 1961, Vol. 65D, No. 1, pp. 67–74.) An examination of propagation data taken at 100 Mc/s over 21 paths in the U.S.A. shows that the surface value of atmospheric refractive index is well correlated with the annual cycle of radio transmission loss.

621.391.812.622.029.64 **1981**

Characteristics of Maritime Advective Duct and their Effect on the Microwave Propagation Beyond the Line of Sight.—A. Takahira & H. Irie. (*J. Radio Res. Labs., Japan*, Sept. 1960, Vol. 7, No. 33, pp. 531–544.) Helicopters were used to make measurements of atmospheric refractive index over the sea along the radio wave path. It is possible to predict the profile of the M curve over the sea up to 20 km from the coast line.

621.391.812.624.029.63 **1982**

Correlation between Amplitudes of Radio Waves of Different Frequencies

in U.H.F. Beyond-the-Horizon Propagation.—M. Hirai, M. Fukushima & Y. Kurihara. (*J. Radio Res. Labs, Japan*, Sept. 1960, Vol. 7, No. 33, pp. 509–529.) Selective fading is caused by interference between multipath waves. This is treated theoretically and expressions are derived for the amplitude correlation coefficient, the distribution of amplitude ratios and the distribution of multiple-path delays. A comparison is made between these theoretical formulae and experimental data.

621.391.812.63 **1983**

Wave Interaction in Plasma Inhomogeneities.—L. Wetzel. (*J. appl. Phys.*, Feb. 1961, Vol. 32, No. 2, pp. 327–328.) The perturbation of electron density giving rise to first-order combination frequencies [3847 of 1959 (Ginzburg)] is deduced for the case of a spatially homogeneous plasma and compared with the perturbation normally giving rise to second-order wave interaction in a homogeneous plasma.

621.391.812.63 **1984**

Focusing of Radio Waves Reflected from a Rough Curved Ionosphere.—J. D. Whitehead. (*Aust. J. Phys.*, Dec. 1960, Vol. 13, No. 4, pp. 621–624.) The increase in echo amplitude due to focusing by a rough curved ionosphere is shown to be given by the same formula as that for a smooth ionosphere (see 914 of 1957), but different areas of reflection are effective in the two cases, and as a result large amplitude increases are not expected in the rough case.

621.391.812.63 **1985**

Perpendicular Intersections with a Dipole Field.—M. H. Cohen & M. L. Dwarkin. (*J. geophys. Res.*, Feb. 1961, Vol. 66, No. 2, pp. 411–419.) "This paper deals with the geometry of radio rays originating at an arbitrary point in a force-free dipole magnetic field. The echo surface, defined by the points where the rays intersect the field at right angles, is calculated. The distance from the source point to the echo surface is computed and plotted for various configurations."

621.391.812.63 **1986**

Radio Wave Reflections from the Mesosphere: Part I—Heights of Occurrence.—J. B. Gregory. (*J. geophys. Res.*, Feb. 1961, Vol. 66, No. 2, pp. 429–445.) The height distribution of partial reflections from the lower ionosphere were made in Christchurch, New Zealand, for one year using a frequency of 1·75 Mc/s. Reflections occur most frequently from regions whose lower boundaries are at 86, 78, 66, 61, 55 km. Some small seasonal trends were noticed. The reflections are thought to be due to turbulent scatter in the presence of a gradient of electron density at certain preferred heights.

621.391.812.63: 523.78 **1987**

Behaviour of Broadcast-Frequency Waves at Oblique Incidence during an Annular Eclipse.—R. K. MacCrone & F. R. N. Nabarro. (*J. atmos. terr. Phys.*, March 1961, Vol. 20, Nos. 2/3, pp. 200–205.) Abrupt increases in received signal strength for oblique incidence are observed during an annular eclipse. The mechanism suggested is a Chapman solar-particle eclipse causing sudden changes in reflection heights from D to E region.

621.391.812.63: 551.510.535 **1988**

On the Evaluation of the Group Refractive Index in Case of No Collisions.—H. Unz. (*J. atmos. terr. Phys.*, March 1961, Vol. 20, Nos. 2/3, pp. 189–194.) An alternative method of evaluating the group refractive index μ' in magneto-ionic theory is shown. Expressions are derived, simpler than those given e.g. by Shinn & Whale (1405 of 1952), and particularly suitable for calculating μ and μ' near the reflection point.

621.391.812.63 : 621.396.677 **1989**

Launching Over the Sea of Vertically Polarized Waves for Long-Distance Ionospheric Propagation.—Willoughby. (See 1733.)

621.391.812.63.029.4 **1990**

Magneto-ionic Propagation Phenomena in Low- and Very-Low-Radio-frequency Waves Reflected by the Ionosphere.—J. R. Johler. (*J. Res. nat. Bur. Stand.*, Jan./Feb. 1961, Vol. 65D, No. 1, pp. 53–65.) An analysis illustrating the dependence of the amplitude and phase of the reflected wave upon the direction of propagation relative to the direction of the earth's magnetic field. A plane sharply bounded ionosphere with plane-wave excitation is used. Tables applicable to v.l.f. propagation are given.

621.391.812.63.029.45 **1991**

A New Approach to the Mode Theory of V.L.F. Propagation.—J. R. Wait. (*J. Res. nat. Bur. Stand.*, Jan.–Feb. 1961, Vol. 65D, No. 1, pp. 37–46.) Approximate forms of the wave functions appropriate to grazing incidence are introduced which lead to relatively concise results for the influence of the earth's curvature; influence of the earth's magnetic field is also discussed. Numerical results for the attenuation and phase velocity of the dominant mode are given.

621.391.812.63.029.45 **1992**

East-West Effect on V.L.F. Mode Transmission across the Earth's Magnetic Field.—D. Dobrott & A. Ishimaru. (*J. Res. nat. Bur. Stand.*, Jan.–Feb. 1961, Vol. 65D, No. 1, pp. 47–52.) An analysis for modes propagating within a parallel-plate waveguide, the lower boundary being a perfect conductor and the upper a sharply defined semi-infinite plasma with a constant magnetic field applied. Some agreement with experimental results is found.

621.391.812.63.029.45 **1993**

Waveguide-Mode Propagation of Very-Low-Frequency Radio Waves.—H. G. Martin. (*J. atmos. terr. Phys.*, March 1961, Vol. 20, Nos. 2/3, pp. 206–209.) Theoretical calculations on the E-W asymmetry of v.l.f. wave propagation.

621.391.812.63.029.45 **1994**

Random Fluctuations in Very-Low-Frequency Signals Reflected Obliquely from the Ionosphere.—J. K. Hargreaves. (*J. atmos. terr. Phys.*, March 1961, Vol. 20, Nos. 2/3, pp. 155–166.) The fluctuations of signals from v.l.f. transmitters at distances of 800 and 6 000 km were respectively 0·15 and 1·02 of the mean amplitude. The results could be explained by a model with constant reflection coefficient but varying height.

621.391.812.63.029.45: 523.5 **1995**

V.L.F. Phase Perturbation associated with Meteor Shower Activity.—C. J. Chilton. (*J. geophys. Res.*, Feb. 1961, Vol. 66, No. 2, pp. 379–383.) The diurnal phase variations of radio waves from Rugby, England, on 16 kc/s were measured at Boulder, Colorado. Anomalous phase changes were detected when the Lyrid, Aquarid and Perseid meteor showers occurred and the reasons have not been explained. The height of reflection was approximately 80 km.

621.391.812.631: 551.510.535(98) **1996**

Statistical Study in the Occurrence of Polar Blackouts.—Kasuya. (See 1854.)

621.371: 061.3 **1997**

Electromagnetic Wave Propagation. [Book Review]—M. Desirant & J. L. Michiels (Eds). Publishers: Academic Press, London, 1960, 730 pp., 157s. (*J. atmos. terr. Phys.*, March 1961, Vol. 20, Nos. 2/3, pp. 222–223.) The text of 54 papers presented at a conference associated with the International Exhibition in Brussels, 1958.

RECEPTION

621.376.23 **1998**

Zeros of a Stationary Random Signal.—H. Debart. (*Câbles & Transm.*, July 1960, Vol. 14, No. 3, pp. 191–199.) Application of the Loeve-Karhunen expansion to the approximate calculation of the probability functions $P_0(t)$ ... $P_n(t)$, probabilities for which, in the time interval t, there will be a prescribed number of zero crossings.

621.376.23: 621.372.54 **1999**

Self-Adaptive Filter finds Unknown Signal in Noise.—C. V. Jakowatz & G. M. White. (*Electronics*, 17th Feb. 1961, Vol. 34, No. 7, pp. 117–119.) An automatic system forms a stored image of the signal after several occurrences. The system alters the stored image as the shape of the signal varies, and forms an optimum filter.

621.376.23: 621.394.422 **2000**

Likelihood Detection of Small Signals in Stationary Noise.—P. Rudnick. (*J. appl. Phys.*, Feb. 1961, Vol. 32, No. 2, pp. 140–143.) An approximation for the detection probability ratio is derived, applicable to any sufficiently long observation period.

621.391.812.624.029.63 **2001**

Variation in Received Signal Power with Narrow-Beam Antennas Rotated Horizontally in U.H.F. Beyond-the-Horizon Propagation.—M. Hirai, H.

Inoue & Y. Kido. (*J. Radio Res. Labs, Japan*, Sept. 1960, Vol. 7, No. 33, pp. 487–507.) The received signal power depends on the mode of propagation, the geometry of the path and the speed of aerial rotation in addition to the aerial directivities. Assuming tropospheric scatter propagation, the aerial patterns are derived for different distributions of dielectric-constant irregularities and compared with experimental data.

621.396.62 : 523.164 **2002**

A 75-cm Receiver for Radio Astronomy and some Observational Results.—Seeger, Stumpers & van Hurck. (See 1816.)

621.396.62 : 523.53 **2003**

Noise Suppression in Pulse Receivers.—E. C. McLauchlan. (*Aust. J. Phys.*, Dec. 1960, Vol. 13, No. 4, pp. 750–752.) Modifications to a receiver system used for measuring meteor rates by radar methods are described. The gain of the video stage is a function of the steady background noise but is unaffected by the signal pulses. The reliability of echo rates during periods of high noise is increased.

STATIONS AND COMMUNICATION SYSTEMS

621.376.56 : 621.397 **2004**

Some Techniques of Pulse Code Modulation.—W. Neu. (*Bull. schweiz. elektrotech. Ver.*, 8th Oct. 1960, Vol. 51, No. 20, pp. 978–987. In English.) Various types of code and methods of code conversion are discussed, and a 54-level valve-type and an 81-level transistor-type coder for television are described.

621.391 : 621.376.56 **2005**

Design and Performance of Hyperbolic Binary Encoders.—C. P. Villars. (*Bull. schweiz. elektrotech. Ver.*, 8th Oct. 1960, Vol. 51, No. 20, pp. 987–990. In French.)

621.396.4 : 523.3 **2006**

Band-Pass Measurements of a Lunar Reflection Circuit.—R. P. Ingalls, L. E. Bird & J. W. B. Day. (*Proc. Inst. Radio Engrs*, March 1961, Vol. 49, No. 3, pp. 631–632.) The correlation between signals at frequencies separated by up to 10 kc/s has been measured. In speech transmission tests s.s.b. modulation was superior to f.m.

621.396.65 **2007**

Intermediate-Frequency Section of a F.M. Radio-Link Installation with Small Number of Channels.—A. Schellenberg. (*Bull. schweiz. elektrotech. Ver.*, 8th Oct. 1960, Vol. 51, No. 20, pp. 971–977.) Design procedure and theoretical and measured characteristics are given for a 42-Mc/s i.f. stage in seven-channel R/T equipment.

621.396.72-519 **2008**

Remote Control Equipment for Unattended Telecommunication Stations.—E. Baranowski. (*Telefunken Ztg*, June 1960, Vol. 33, No. 128, pp. 109–119. English summary, p. 157.) The equipment described comprises rack-mounted units for remote supervision and control of repeater and relay stations. The transmission of 'reports' and 'commands' is carried out by means of pulse trains which actuate stepping selector switches.

621.396.945 **2009**

Subsurface Communication for Survival.—R. N. Ghose. (*Electronics*, 3rd Feb. 1961, Vol. 34, No. 5, pp. 43–45.) Theory of a system using underground transmitters and aerials is given.

SUBSIDIARY APPARATUS

621.311.62 : 537.54 **2010**

A 30-Kilowatt, 500-Microsecond Vacuum-Tube Pulser.—R. A. Kawcyn. (*Rev. sci. Instrum.*, Jan. 1961, Vol. 32, No. 1, pp. 56–57.) A full description is given of a circuit designed for operation of gas-discharge tubes in plasma research.

621.311.69 : 621.383.5 **2011**

Distribution of Losses and the Efficiency of Different Processes in Photoelectric Solar Energy Converters.—V. K. Subashiev. (*Fiz. Tverdogo Tela*, Feb. 1960, Vol. 2, No. 2, pp. 198–204.) An attempt at a quantitative analysis of essential processes.

621.352 : 541.135.6 **2012**

Theory of Electrochemical Diodes.—I. Oshida. (*J. phys. Soc. Japan*, Dec. 1960, Vol. 15, No. 12, pp. 2288–2294.) A theoretical analysis is given of the behaviour of an electrochemical diode, based on the equation of diffusion of ions. The non-ohmic characteristic, the shunting effect observed with a rapidly changing voltage, and the rectifying action are determined.

TELEVISION AND PHOTOTELEGRAPHY

621.397.132(4) : 389.6 **2013**

Standardization of European Colour Television.—W. Gerber. (*Bull. schweiz. elektrotech. Ver.*, 8th Oct. 1960, Vol. 51, No. 20, pp. 994–999.) The development of existing monochrome standards is reviewed. The discussion deals mainly with the use of the 625-line standards for colour television transmission by the N.T.S.C. method or its variants, and with related problems of program exchange, transmitter planning and receiver design.

621.397.2 **2014**

Storage and Frequency-Band Compression in Television.—F. Schröter. (*Bull. schweiz. elektrotech. Ver.*, 8th Oct. 1960, Vol. 51, No. 20, pp. 999–1008.) The possibilities of reducing television bandwidth by using storage-type picture tubes and taking advantage of the persistence of vision are discussed.

621.397.23 : 621.396.65 **2015**

Transmission of Slow Television Pictures over Telephone or Radiotelephone Links.—A. Cazalas & B. Picot. (*C. R. Acad. Sci., Paris*, 9th May 1960, Vol. 250, No. 19, pp. 3140–3141.) An outline is given of a narrow-band system using an isoscope camera tube developed by Barthélemy (445 of 1946), and a receiver having a display tube with a screen which turns a violet-purple colour under electron bombardment.

621.397.331.22 **2016**

A Plug-Type Image-Orthicon Target.—S. A. Ochs. (*RCA Rev.*, Dec. 1960, Vol. 21, No. 4, pp. 559–569.) A new type of target consisting of an array of metal plugs embedded in Al oxide insulating film has been investigated. It has high resolution at low light levels, and may be of use as a storage plate.

621.397.61-519 **2017**

San Salvatore—the First Remotely Controlled Television Relay Station in Switzerland.—E. Schwarz. (*Tech. Mitt. PTT*, 1st June 1960, Vol. 38, No. 6, pp. 201–205. In German and Italian.) The remote control of the standard-type video and sound transmitters used is effected by means of pulse signals transmitted via telephone lines.

621.397.611 : 621.317.083.74 **2018**

I.R.E. Standards on Video Techniques: Measurement of Resolution of Camera Systems, 1961.—(*Proc. Inst. Radio Engrs*, March 1961, Vol. 49, No. 3, pp. 599–602.) Standard 60 I.R.E. 23.S2.

TRANSMISSION

621.396.61 **2019**

A Novel Type of High-Power Pulse Transmitter.—K. Landecker & K. S. Lurie. (*Aust. J. Phys.*, Dec. 1960, Vol. 13, No. 4, pp. 638–654.) A symmetrical array of capacitors, charged and discharged as in the Marx impulse generator, is used to generate radio waves. The structure forms the tank circuit and the radiating magnetic dipole, and is capable of producing peak powers of the order of 10^8 MW.

621.396.61 : 621.395 **2020**

Transmission Characteristics of Anode-Modulated Telephony Transmitters with Highly Selective Aerials.—M. Dick. (*Bull. schweiz. elektrotech. Ver.*, 8th Oct. 1960, Vol. 51, No. 20, pp. 963–971.) Distortion, phase modulation and other problems arising from the use of aerials of less than optimum length for long-wave transmitters are investigated theoretically and methods of minimizing the adverse effects are given. Measurements to check the theoretical results were made on a

200-kc/s, 10-kW transmitter feeding an aerial whose electrical length is about 13% of $\lambda/4$.

VALVES AND THERMIONICS

621.382 + 537.311.33]:061.3 **2021**

International Convention on Transistors and Associated Semiconductor Devices.—(*Proc. Instn elect. Engrs*, Part B, 1959, Vol. 106, Supplements Nos. 15–18, pp. 265–570, 571–842, 843–1102 & 1103–1398.) The text is given of the papers presented and the session discussions at the I.E.E. Convention held in London, 21st–27th May 1959.

621.382.2/.3 **2022**

Effects of Electrons and Holes on the Transition-Layer Characteristics of Linearly Graded *p-n* Junctions.—C. T. Sah. (*Proc. Inst. Radio Engrs*, March 1961, Vol. 49, No. 3, pp. 603–618.) The d.c. theory of *p-n* junctions has been extended, taking into account the mobile carriers or electrons and holes in the transition region. Under forward-bias conditions both the transition-layer width and carrier capacitance increase exponentially with voltage.

621.382.22:621.318.57 **2023**

A 100-dB Microwave Semiconductor Switch.—D. W. Feldman & R. R. McAvoy. (*Rev. sci. Instrum.*, Jan. 1961, Vol. 32, No. 1, pp. 74–76.) "A dual-diode microwave switch providing in excess of 100-dB switched attenuation with low insertion loss is described. Switching time of the device, limited by the diodes, is 3×10^{-9} sec. Application of the switch in a 9-Gc/s superheterodyne magnetic resonance spectrometer as a mixer crystal protector and as a microwave signal blanker is described."

621.382.23 **2024**

The Current Ratio I_{max}/I_{min} of Tunnel Diodes.—M. Michelitsch. (*Naturwissenschaften*, June 1960, Vol. 47, No. 12, p. 278.) The ratio is shown to be strongly dependent on the duration of the alloying time.

621.382.23 **2025**

Current-Voltage Characteristics of Alloyed and Diffused *p-n* Junction Diodes in InSb.—H. J. Stocker. (*J. appl. Phys.*, Feb. 1961, Vol. 32, No. 2, p. 322.) Measurements on sample diodes at liquid-nitrogen temperatures are described. The rectification ratios are two orders of magnitude higher than previously reported in the literature.

621.382.23:621.372.44 **2026**

High-Frequency Varactor Diodes.—C. W. Mueller & R. D. Guld. (*RCA Rev.*, Dec. 1960, Vol. 21, No. 4, pp. 547–557.) Fabrication, impurity distribution, and the measurement of electrical characteristics at 2 Gc/s are described. These diodes have been used as phase-locked oscillators up to 17 Gc/s (pump frequency 30 Gc/s) and also in microwave strip-line amplifiers.

621.382.233:621.318.57 **2027**

Theoretical Current Multiplication of a Cylindrical Hook Collector.—D. P. Kennedy. (*IBM J. Res. Develop.*, Jan. 1961, Vol. 5, No. 1, pp. 25–32.) A theoretical analysis of the "hook collector" which is an integral part of most four-layer, *p-n-p-n*, semiconductor switches. Design equations are presented in graphical form.

621.382.3 **2028**

Some Transconductance Measurements on Transistors.—C. Milone. (*Note Recensioni Notiz.*, May/June 1960, Vol. 9, No. 3, pp. 541–553.) Investigations of commercial-type transistors in earthed-emitter configuration under various operating conditions.

621.382.3 **2029**

Transistor Upper Noise Corner Frequency.—H. F. Cooke. (*Proc. Inst. Radio Engrs*, March 1961, Vol. 49, No. 3, p. 648.) Measured values of the upper noise corner frequency of four types of transistor have been compared with values calculated from (*a*) the classical formula [757 of 1959 (Shea)], (*b*) a more exact form of the expression derived by Nielsen (3337 of 1957) and (*c*) the expression used in (*b*) but substituting the transition frequency f_T in place of f_α. Over a range of cut-off frequencies from 40 to 600 Mc/s very good agreement was obtained between the measured values and those calculated by method (*b*).

621.382.3-71 **2030**

Heat Dissipation of Transistors.—W. Hilberg. (*Telefunken Ztg*, Sept. 1959, Vol. 32, No. 125, pp. 200–207. English summary, pp. 211–212.) From a consideration of the heat conduction and dissipation processes in a transistor an equivalent circuit for the heat dissipation under static conditions is derived. Calculations regarding the thermal characteristics under dynamic conditions are based on this circuit and several simplifying assumptions. Methods are described for determining the barrier-layer temperature from measurements of transistor operating characteristics.

621.382.333 **2031**

A *p-n-p* High-Frequency Silicon Transistor.—W. A. Little. (*J. electrochem. Soc.*, Sept. 1960, Vol. 107, No. 9, pp. 789–791.) The construction and electrical characteristics of a double-diffused transistor are described.

621.382.333:621.318.57 **2032**

Properties and Applications of Junction Transistors as Switches.—G. Meyer-Brötz. (*Telefunken Ztg*, June 1960, Vol. 33, No. 128, pp. 85–98. English summary, p. 136.) The basic static and dynamic characteristics of junction transistors are examined for suitability in switching applications. The design of electronic switches with minimum residual voltage and current, and of transistor modulators for amplifier control is also considered. 44 references.

621.382.333.002.2 **2033**

Conditions for Obtaining Transistors Transistors by Double Diffusion.—R. Deschamps. (*C. R. Acad. Sci., Paris*, 9th May 1960, Vol. 250, No. 19, pp. 3137–3139.) A theoretical examination of conditions necessary for the production of an *n-p-n*-type transistor.

621.382.333.002.2 **2034**

Conditions for Applying Double Diffusion to Obtain Germanium Transistors.—R. Deschamps. (*C. R. Acad. Sci.*, Paris, 16th May 1960, Vol. 250, No. 20, pp. 3290–3292.) Experimental results are described which confirm the theoretical conditions laid down in a previous paper (2033 above).

621.383.292.001.4 **2035**

Investigations of the Local Characteristics of Photomultipliers.—P. Cachon. (*Ann. Télécommun.*, Sept.–Oct. 1960, Vol. 15, Nos. 9/10, pp. 220–234.) Detailed report of work noted earlier (736 of February).

621.383.5 **2036**

Energy Diagram of a Real Silicon Photocell.—V. K. Subashiev & É. M. Pedyash. (*Fiz. Tverdogo Tela*, Feb. 1960, Vol. 2, No. 2, pp. 213–220.) Description of a method for constructing the energy diagram of a photocell with its equilibrium carrier concentration. Two examples relating to photocells obtained by diffusion of Sb into *p*-type Si show the necessity for considering the field and potential drop in the diffusion layers when studying the operation of a cell.

621.383.5 **2037**

The Theory of Photocells with a *p-n* Junction.—B. Ya. Moizhes. (*Fiz. Tverdogo Tela*, Feb. 1960, Vol. 2, No. 2, pp. 221–226.) Investigation of the effect of the distributed impedance of the current-removal layer on the characteristics of the photocell and of the movement of minority carriers in the diffusion layer taking account of the extended field and the changing mobility.

621.384.64 **2038**

Statistical Equilibrium of an Electron Space Charge with Cylindrical Symmetry in a Magnetron.—J. Coste & L. Dugras. (*C. R. Acad. Sci., Paris*, 2nd May 1960, Vol. 250, No. 18, pp. 3009–3011.)

621.385.029.6 **2039**

Systematization and Technical State of Microwave Valves.—L. Brück & W. Klein. (*Frequenz*, June 1960, Vol. 14, No. 6, pp. 198–210.) Transit-time valves and disk-seal triodes are reviewed with details of several commercial types.

621.385.032.21 **2040**

Potential Distribution about a Sectored Cathode.—E. Weber. (*Bull. schweiz. elektrotech. Ver.*, 8th Oct. 1960, Vol. 51, No. 20, pp. 1011–1014. In English.) The potential distribution is determined by means of the method of conformal mapping.

621.385.032.213 **2041**

Thermionic Emission Constants and their Interpretation.—E. B. Hensley. (*J. appl. Phys.*, Feb. 1961, Vol. 32, No. 2, pp. 301–308.) A critical review of the

procedures used in the measurement and interpretation of thermionic emission with particular reference to nonmetallic cathodes.

621.385.2 : 621.391.822 : 621.372 **2042**

Nonlinear Thermal Fluctuations in a Diode.—Van Kampen. (See 1742.)

621.385.3 **2043**

Nonlinear Distortion due to Transit Time Effects in Single-Grid Valves.—H. Leysieffer. (*Arch. elekt. Übertragung*, June 1960, Vol. 14, No. 6, pp. 269–282.) Investigation of the relation between transit phase angle and distortion dependent on transit time in amplifier triodes for use in a.m.b. radio-link systems. Calculations deal with cubic distortion only as the phase can give rise to interference in the d.m.b. range considered. Conditions in the cathode-grid and grid-anode spaces are treated separately. Measurements made for transit phase angles up to about 140° give results in closer agreement with theory for the grid-anode space than for the cathode-grid space.

621.385.6 + 621.382.23] : 621.375.029.6 **2044**

Amplification — Modern Trends, Techniques and Problems.—L. S. Nergaard. (*RCA Rev.*, Dec. 1960, Vol. 21, No. 4, pp. 485–507.) A review of the characteristics of travelling-wave tubes, tunnel diodes, parametric amplifiers and masers.

621.385.624 **2045**

The Amplification of Multiresonator Klystrons.—H. Hagger. (*Bull. schweiz. elektrotech. Ver.*, 8th Oct. 1960, Vol. 51, No. 20, pp. 1041–1046.) The gain of *n*-resonator klystrons is calculated using Derfler's theory of electron-beam interaction with a space-periodic structure (3438 of 1955). Results obtained are compared with theoretical and experimental data for various klystrons.

621.385.63 : 621.375.9 : 621.372.44 **2046**

Energy Balance in a Parametric Electron-Beam Amplifier.—G. K. Grau. (*Arch. elekt. Übertragung*, June 1960, Vol. 14, No. 6, pp. 247–255.) General energy relations are derived for the longitudinal parametric electron-beam amplifier. Using the principles adopted by Kogelnik (4245 of 1959) d.c. and a.c. energy flows can be separated. The energy relations obtained correspond to the Manley-Rowe relations and are discussed with reference to the analysis of Roe & Boyd (3240 of 1959).

621.385.63 : 621.375.9 : 621.372.44 **2047**

Coupled-Mode Theory of Electron-Beam Parametric Amplification.—R. W. Gould & C. C. Johnson. (*J. appl. Phys.*, Feb. 1961, Vol. 32, No. 2, pp. 248–258.) The theory is applied to amplification by transverse fields. Beam modes at a series of frequencies in addition to the signal frequency are coupled together. Quadrupole electric pump fields and the noise contribution from synchronous beam modes and higher cyclotron idler modes are discussed. Coupling by axially symmetric electric and magnetic fields, and lens effects on noise in the gun region are considered.

621.385.63 : 621.375.9 : 621.372.44 **2048**

A Cyclotron Wave Amplifier with Magnetic Pumping.—P. N. Rehorn. (*Proc. Inst. Radio Engrs*, March 1961, Vol. 49, No. 3, pp. 645–646.) A transverse twisting magnetic field is used to couple the fast and slow cyclotron waves.

621.385.63 : 621.391.822 **2049**

Reduction of Beam Noise near by means of a Potential Minimum away from the Cathode.—M. M. Mueller. (*Proc. Inst. Radio Engrs*, March 1961, Vol. 49, No. 3, pp. 642–643.) A sudden discontinuous decrease in the noise figure of a travelling-wave tube was observed as the potential of the profile-shaping electrode was increased. This effect is discussed in relation to a simultaneous drop in the collector current. Explanations for the discontinuities are suggested. See also 1727 of 1959 (Currie & Forster).

621.385.632 **2050**

Bi-signal Amplification by a Forward-Wave Crossed-Field Amplifier.—R. J. Collier. (*Proc. Inst. Radio Engrs*, March 1961, Vol. 49, No. 3, p. 646.) Simultaneous amplification of two pulsed signals differing in frequency has been observed at X-band frequencies using a forward-wave crossed-field amplifier with emitting sole whose gain characteristics have been described earlier (*ibid.*, Jan. 1961, Vol. 49, No. 1, p. 372.) Results indicate that the system operates as a saturated amplifier rather than a locked oscillator.

621.385.69 **2051**

A Proposed Doppler-Helitron Oscillator.—B. W. Hakki. (*Proc. Inst. Radio Engrs*, March 1961, Vol. 49, No. 3, p. 626.) A method is proposed for magnifying the cyclotron frequency of a helical electron beam by 20–100 times through a Doppler shift.

621.385.832 **2052**

The Cathode Loading Limit in Circular-Beam Electron Devices.—H. Moss. (*J. Brit. Instn Radio Engrs*, Jan. 1961, Vol. 21, No. 1, pp. 35–39.) The analyses of Haine (2993 of 1957) and Schwartz (4054 of 1957) are extended and combined to develop a semi-universal curve which shows that low cathode loadings (0·1 A/cm²) are sufficient to cause severe beam focus degradation, due to space charge effects, for spot sizes common in normal c.r. tubes.

621.385.832 **2053**

Selective Erasure and Nonstorage Writing in Direct-View Half-Tone Storage Tubes.—N. H. Lehrer. (*Proc. Inst. Radio Engrs*, March 1961, Vol. 49, No. 3, pp. 567–573.) A new type of storage tube that can erase selectively and display simultaneously stored and nonstored information has been developed. It incorporates a dual-effect target using secondary emission for writing and bombardment-induced conductivity for erasure.

621.385.832 : 621.396.963.3 **2054**

Practical Tubes for Bright Radar Displays.—F. S. Veith. (*Bull. schweiz. elektrotech. Ver.*, 8th Oct. 1960, Vol. 51, No. 20, pp. 1025–1030. In English.) Display and scan-conversion storage tubes are described.

621.387 : 621.318.57 **2055**

The Use of a Hot-Cathode Gas Diode for making a Short Sharp Interruption of Microwave Transmission.—M. Laporte. (*C. R. Acad. Sci., Paris*, 9th May 1960, Vol. 250, No. 19, pp. 3145–3146.) The relative performance of hot- and cold-cathode T-R switches are considered and a helium-filled hot-cathode type is proposed having a permanently applied anode voltage which is slightly less than the ionizing potential of the gas.

621.387 : 621.318.57 **2056**

Study and Experimental Investigation of a Hot-Cathode Gas Diode for the Construction of a Microwave Switch.—J. Goulart. (*C. R. Acad. Sci., Paris*, 16th May 1960, Vol. 250, No. 20, pp. 3299–3301.) Following the proposal of Laporte (2055 above), experimental results have been obtained using a hot-cathode T-R switch. These show a more rapid response time and a greater sensitivity than can be obtained using a cold-cathode type of cell.

621.387 : 621.362 **2057**

A New Thermionic Generator.—Gabor. (See 1969.)

621.387 : 621.362 **2058**

Low-Frequency Oscillations in a Filamentary-Cathode Cesium Diode Converter.—Luke & Jamerson. (See 1970.)

621.387 : 621.374.32 **2059**

A Gas-Discharge Indicator Tube for Transistorized Decade Counting Circuits.—T. P. J. Botden. (*Philips tech. Rev.*, 4th Aug. 1960, Vol. 21, No. 9, pp. 267–275.) Description of an indicator tube which responds to the small signals delivered by transistor circuits.

MISCELLANEOUS

061.3 : [537.311.33 : 621.382 **2060**

International Semiconductor Symposium.—(*Wireless World*, April 1961, Vol. 67, No. 4, p. 191.) Brief report of the symposium organized by the S.F.E.R. and held in Paris, 20th–25th February 1961.

061.4 : 621.3 **2061**

Physical Society Exhibition [1961].—(*Wireless World*, March 1961, Vol. 67, No. 3, pp. 106–115.) Brief descriptions are given of selected exhibits.

001.891 : 621.396 **2062**

Radio Research 1959: The Report of the Radio Research Board and the Report of the Director of Radio Research. [Book Review]—Publishers: H.M. Stationery Office, London, 1960, 34 pp., 3s. (*Nature, Lond.*, 18th Feb. 1961, Vol. 189, No. 4764, pp. 539–540.)

Abstracts and References

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ACOUSTICS AND AUDIO FREQUENCIES

534.213.4 **2063**

On the Transmission of Acoustic Waves through a Circular Channel of a Thick Wall.—Y. Nomura & S. Inawashiro. (*Sci. Rep. Res. Inst. Tohoku Univ., Ser. B*, 1960, Vol. 12, No. 1, pp. 57–71.)

534.232-14: 534.6.089.6 **2064**

Sonar Transducer Pulse Calibration System.—J. D. Wallace & E. W. McMorrow. (*J. acoust. Soc. Amer.*, Jan. 1961, Vol. 33, No. 1, pp. 75–84.) The development of equipment and techniques for making measurements on underwater transducers is described.

534.283-8: 537.312.62 **2065**

Ultrasonic Attenuation in Superconductors.—T. Tsuneto. (*Phys. Rev.*, 15th Jan. 1961, Vol. 121, No. 2, pp. 402–415.) A general treatment of ultrasonic attenuation of both longitudinal and transverse waves in superconductors is given on the basis of the Bardeen-Cooper-Schrieffer theory.

534.441.2 **2066**

An Acoustic Spectrum Analyser with Electronic Scanning.—D. J. H. Admiraal. (*Philips tech. Rev.*, 24th Oct. 1960, Vol. 21, No. 12, pp. 349–356.) Improvements have been made to earlier equipment [*ibid.* 1942, Vol. 7, pp. 50–58 (Beljers)] by using semiconductor diodes and transistors.

534.614-8: 621.3.018.75 **2067**

Pulse Superposition Method for Measuring Ultrasonic Wave Velocities in Solids.—H. J. McSkimin. (*J. acoust. Soc. Amer.*, Jan. 1961, Vol. 33, No. 1, pp. 12–16.) Details are given of a pulse superposition technique which takes into account the coupling effect when a quartz transducer is cemented to the specimen.

534.8 **2068**

Some Periodic Variations in Low-Frequency Acoustic Ambient Noise Levels in the Ocean.—G. M. Wenz. (*J. acoust. Soc. Amer.*, Jan. 1961, Vol. 33, No. 1, pp. 64–74.)

534.84 **2069**

New Distortion Criterion.—E. R. Wigan. (*Electronic Technol.*, April & May 1961, Vol. 38, Nos. 4 & 5, pp. 128–137 & 163–174.) A formula, described as the 'distortion criterion', is derived from the results of an analysis of audience reaction to nonlinear distortion.

534.84 **2070**

The Damping of 'Eigentones' in Small Rooms by Helmholtz Resonators.—F. J. van Leeuwen. (*E.B.U. Rev.*, Aug. 1960, No. 62A, pp. 155–161.) The natural oscillation or 'boom' of small rooms is considered theoretically. Damping of this effect can be achieved by means of small Helmholtz resonators. A design formula is given for these resonators, and suggestions are made regarding installation.

534.844.1 + [621.317.2: 538.566.08 **2071**

Reverberation Chamber Technique and Construction of a Large Reverberation Chamber for Electromagnetic Waves.—Meyer, Helberg & Vogel. (See 2325.)

621.395.623.7.001.4 **2072**

Performance Tests on Loudspeakers.—M. T. Haitjema, W. Kopinga & S. J. Porte. (*Philips tech. Rev.*, 24th Oct. 1960, Vol. 21, No. 12, pp. 362–372.) Sound pressure, electrical impedance and efficiency are measured as a function of frequency. Methods of determining transient response, resonance frequency and directivity are given.

AERIALS AND TRANSMISSION LINES

621.372.2 **2073**

The Helix as a Transmission Line for Waveguide Modes.—G. Piefke. (*Nachrichtentech. Z.*, July 1960, Vol. 13, No. 7, pp. 335–341.) Results of earlier work (e.g. 2459 of 1959) are summarized and discussed treating the helical line as a waveguide in any external medium and taking account of the finite wire thickness.

621.372.2: 537.312.62 **2074**

Field Solution for a Thin-Film Superconducting Strip Transmission Line.—J. C. Swihart. (*J. appl. Phys.*, March 1961, Vol. 32, No. 3, pp. 461–469.) A sinusoidal wave solution is found for a superconducting transmission line. This solution gives a slow mode of propagation. At low temperatures and frequencies where

losses are low, the velocity is dispersionless. The solutions are continuous through the critical temperature. A lumped-circuit interpretation is given.

621.372.2: 621.319.74 **2075**

The External Electromagnetic Fields of Shielded Transmission Lines.—J. D. Meindl & E. R. Schatz. (*Proc. Inst. Radio Engrs*, April 1961, Vol. 49, No. 4, p. 816.)

621.372.2: 621.372.44: 621.375.9 **2076**

Interpretation of the Transmission-Line Parameters with a Negative-Conductance Load and Application to Negative-Conductance Amplifiers.—C. T. Stelzried. (*Proc. Inst. Radio Engrs*, April 1961, Vol. 49, No. 4, pp. 812–813.) Expressions are given for the reflection coefficient, power available and standing-wave ratio.

621.372.2: 621.372.51 **2077**

Note on a Balun: Solution by a Tapered Potential.—C. C. Eaglesfield. (*Proc. Inst. Radio Engrs*, April 1961, Vol. 49, No. 4, pp. 810–811.) The intuitive design of Duncan & Minerva (1489 of 1960) has been replaced by a design depending on an analytic approach.

621.372.8.049.7 **2078**

Waveguide Components—a Survey of Methods of Manufacture and Inspection.—D. J. Doughty. (*J. Brit. Instn Radio Engrs*, Feb. 1961, Vol. 21, No. 2, pp. 169–189.) 59 references.

621.372.81 **2079**

Theory of Waveguides and Cavities: Part 3—Perturbation Theory and its Applications.—R. A. Waldron. (*Electronic Technol.*, May 1961, Vol. 38, No. 5, pp. 178–183.) Two applications are considered, (*a*) the use of a cavity to measure the dielectric constant of a solid, and (*b*) the attenuation in a waveguide due to the dielectric loss. Part 2: 1723 of June.

621.372.823 **2080**

Effect of a Radial Discontinuity in a Circular Waveguide on the Propagation of a TE_{01} Wave.—M. Jouguet. (*Câbles & Transm.*, Oct. 1960, Vol. 14, No. 4, pp. 270–274.) The relative amplitudes of various TE_{on}-type parasitic waves ($n > 2$) introduced by the discontinuity are determined.

621.372.823 **2081**

Mode Conversion in Metallic and Helix Waveguide.—H. G. Unger. (*Bell Syst. tech. J.*, March 1961, Vol. 40, No. 2, pp. 613–626.) Mathematical solutions are given for mode conversion and transmission losses due to mechanical imperfections.

621.372.823 **2082**

Winding Tolerances in Helix Waveguide.—H. G. Unger. (*Bell Syst. tech. J.*, March 1961, Vol. 40, No. 2, pp. 627–643.) Various causes of losses in circular electric waves are considered. The most significant loss is shown to be due to an irregular tilt of the winding, for which an expression is derived.

621.372.823: 621.372.83 **2083**

Reflections and Mode Conversions in Imperfect Junctions of TE_{01}-Wave Transmission Line.—K. Noda. (*Rev. elect. Commun. Lab., Japan*, Nov./Dec. 1960 Vol. 8, Nos. 11/12, pp. 549–559.) The effects of tilt and offset between the waveguide axes, and of an elliptical cross-section in one waveguide are calculated.

621.372.823: 621.372.852.23 **2084**

The H_{on} Mode in Circular Waveguide with Equidistant and Coaxially Arranged Band-Shaped Rings of Perfect Conductivity.—H. Buchholz. (*Arch. Elektrotech.*, 1st July 1960, Vol. 45, No. 4, pp. 249–264.) The effect of a periodic structure consisting of thin narrow rings inside a perfectly conducting waveguide is investigated. An approximate solution is derived for the phase shift along this system.

621.372.826 + [621.391.814: 537.56 **2085**

Propagation of Electromagnetic Waves along a Thin Plasma Sheet.—Wait. (See 2352.)

621.372.826: 621.391.814.029.64 **2086**

TE Surface Waves Guided by a Dielectric-Covered Metal Plane.—Morris & Mungall. (See 2353.)

621.372.829: 621.396.677.7 **2087**

Electromechanically Scanned Trough Waveguide Array.—W. Rotman & A. Maestri. (*Electronics*, 3rd March 1961, Vol. 34, No. 9, pp. 54–57.) An asymmetrical obstacle introduced into a trough waveguide changes the transmission from a non-radiating to a radiating mode.

621.372.852.323 **2088**

Theoretical Study of Nonreciprocal Resonant Isolators.—J. B. Davies. (*Philips Res. Rep.*, Oct. 1960, Vol. 15, No. 5, pp. 401–432.) The attenuation in each direction is calculated as a function of frequency for various ferrite shapes within rectangular waveguide propagating the dominant TE mode. Perturbation theory is used and the results are valid only for small volumes of ferrite.

621.396.67.012.12: 621.317.3 **2089**

Measurements on Transmitter Aerials of the Austrian Broadcasting Service with the aid of a Helicopter.—L. Kohlgruber. (*Radiovchau*, July 1960, Vol. 10, No. 7, pp. 248–250.) Brief description of the procedure and technical equipment used for the measurement of horizontal and vertical radiation diagrams of broadcast and television transmitter aerials.

621.396.673.011.21 **2090**

Impedance of a Monopole Antenna with a Circular Conducting-Disk Ground System on the Surface of a Lossy Half-Space.—S. W. Maley & R. J. King. (*J. Res. nat. Bur. Stand.*, March/April 1961, Vol. 65D, No. 2, pp. 183–188.) The base impedance of a $\lambda/4$ monopole is calculated by three different methods, and measured experimentally at 3 cm λ using a water-filled tank.

621.396.677: 523.164 **2091**

The Radio Telescope for 7·9 Metres Wavelength at the Mullard Observatory.—Costain & Smith. (See 2177.)

621.396.677.029.45/.51 **2092**

Some Preliminary Experimental Tests of a Novel Method of Radiating at Very Low Frequencies.—R. N. Gould. (*Nature, Lond.*, 22nd April 1961, Vol. 190, No. 4773, pp. 332–333.) Experiments have been conducted in Scotland to assess the suitability of a long narrow strip of land as a radiator and to determine its characteristics. 3 000 yd of cable were laid across the base of a peninsula 10 miles long, each end of the cable being earthed in the sea, and the transmitter output of 50 W at 10 kc/s was applied to the mid-point. Preliminary results demonstrate the feasibility of the proposals though measurements were marred by capacitance effects between the cable and earth.

621.396.677.3 **2093**

Equivalence between Continuous and Discrete Radiating Arrays.—A. Ksienski. (*Canad. J. Phys.*, Feb. 1961, Vol. 39, No. 2, pp. 335–349.) The agreement between the radiation patterns of arrays of sources and those of continuously illuminated apertures is shown to be close. The effect of varying element spacing is found.

621.396.677.3 **2094**

Two-Element Aerial Array.—V. G. Welsby. (*Electronic Technol.*, May 1961, Vol. 38, No. 5, pp. 160–163.) A two-element multiplicative system is described in which signal waveforms composed of a number of sinusoidal components are used to obtain a directional pattern comparable with that of a multielement additive array. The principle may be applied to give a simplified electronic beam-scanning system.

621.396.677.3.012.12: 681.142 **2095**

An Analogue Computer for Aerial Radiation Patterns.—H. Page, G. J. Phillips & J. A. S. Fox. (*E.B.U. Rev.*, Aug. 1960, No. 62A, pp. 146–149; *Electronic Engng*, April 1961, Vol. 33, No. 398, pp. 206–212.) A detailed description is given of a computer for determining the horizontal radiation patterns of arrays consisting of identical elements. The currents in the elements may have any desired amplitude and phase. See also 2235 of 1960 (Mitchell).

621.396.677.4 **2096**

Plane Aerial with Periodically Bent Conductor.—G. V. Trentini. (*Frequenz*, July 1960, Vol. 14, No. 7, pp. 239–243.) A directional aerial is investigated which consists of a conductor bent periodically in one plane arranged in parallel with a sheet reflector at a spacing of about $\lambda/10$. Narrow-beam radiation can be achieved, the direction of the main beam depending on frequency. Several arrangements, including a four-aerial array for omnidirectional radiation, are discussed.

621.396.677.8 **2097**

Fresnel Region Fields of Circular Aperture Antennas.—M. K. Hu. (*J. Res. nat. Bur. Stand.*, March/April 1961, Vol.

65D, No. 2, pp. 137–147.) An analysis, with numerical results, for aerials with nonuniform illumination.

621.396.677.8 **2098**

Transient Behaviour of Aperture Antennas.—B. R. Mayo: C. Polk. (*Proc. Inst. Radio Engrs*, April 1961, Vol. 49, No. 4, pp. 817–819.) Corrections to 3373 of 1960 are given together with additional conclusions.

621.396.677.85 : 621.396.965 **2099**

A High-Speed Scanning Radar Antenna.—F. Valster. (*Philips tech. Rev.*, 9th Nov. 1960, Vol. 22, No. 2, pp. 29–35.) Describes an experimental installation using a Luneberg-lens scanning system at speeds up to 10 rev/sec. At these speeds the observation of fast-moving objects is greatly improved.

AUTOMATIC COMPUTERS

681.142 **2100**

A Versatile Forcing-Function Generator.—J. Morrison. (*Electronic Engng*, March 1961, Vol. 33, No. 397, pp. 155–159.) An electronic generator for use with analogue computers, which produces sine, square, triangular, ramp, step or impulse functions over the range 0·001–100 c/s to an accuracy within ½%.

681.142 : 517.512.2 **2101**

A Successful Version of the Beevers-Macewan Fourier Synthesizer using Dekatron Counters.—J. W. Jeffery. (*J. sci. Instrum.*, April 1961, Vol. 38, No. 4, pp. 119–125.) A Fourier synthesizer is described which allows a possible 100 harmonics to be specified with amplitudes ranging from 1–100 units. Both positive and negative harmonic components are acceptable. See 248 of 1943 (Macewan & Beevers).

681.142 : 537.226 **2102**

A Dielectric Drum Storage System.—S. Morleigh. (*J. Brit. Instn Radio Engrs*, March 1961, Vol. 21, No. 3, pp. 211–219.) The basic theory of a dynamic electrostatic storage system is given. Experimental results with a ceramic drum are given; packing densities of 80 bits in. were obtained with signal/noise ratios of 12 : 1.

681.142 : 538.221 : 539.23 **2103**

Designing Thin Magnetic Film Memories for High-Speed Computers.—E. E. Bittmann. (*Electronics*, 3rd March 1961, Vol. 34, No. 9, pp. 39–41.) A storage system has been built which will store 320 words each of 8 bits and which has a cycle time of 0·2 μs.

681.142 : 621.374.33 **2104**

Current-Operated Diode Logic Gates.—H. Reinecke, Jr. (*Commun. & Electronics*, Jan. 1961, No. 52, pp. 762–772.) The basic logic circuits are described and practical examples are given.

681.142 : 621.396.677.3.042.12 **2105**

An Analogue Computer for Aerial Radiation Patterns.—Page, Phillips & Fox. (See 2095.)

CIRCUITS AND CIRCUIT ELEMENTS

621.318.57 : 621.372.44 : 539.23 **2106**

Stable-Oscillation Conditions for the Magnetic-Film Parametron.—R. M. Sanders. (*J. appl. Phys.*, March 1961, Vol. 32, No. 3, pp. 478–482.) A mathematical analysis of a parametron is given. This parametron uses a single-domain magnetic film as the core of a nonlinear inductor absorbing energy from an alternating pump field and delivering energy to a signal winding. Graphical means of determining stability conditions, amplitudes and phases of the oscillating variables, and the range of operating frequencies are discussed.

621.318.57 : 621.382.23 : 621.372.44 **2107**

Microwave Bistable Circuits using Varactor Diodes.—C. L. Heizman. (*Proc. Inst. Radio Engrs*, April 1961, Vol. 49, No. 4, pp. 829–830.) Using a 10 Gc/s carrier frequency, switching speed between states was less than 10 ns. A threshold logic circuit with power gain is illustrated.

621.318.57 : 621.382.3 : 621.376 **2108**

Symmetrical Transistors as A.C. or D.C. Switches and their Applications in Modulator and Demodulator Circuits.—J. F. O. Evans, D. A. Gill & B. R. Moffitt. (*J. Brit. Instn Radio Engrs*, Feb. 1961, Vol. 21, No. 2, pp. 143–149.)

621.319.45 **2109**

An Investigation of Columbium as an Electrolytic Capacitor Metal.—A. Shtasel & H. T. Knight. (*J. electrochem. Soc.*, April 1961, Vol. 108, No. 4, pp. 343–347.) The characteristics of capacitors prepared from Cb are very similar to those of Ta, except that the working voltages are about one third and the d.c. leakage currents about double that of similar Ta capacitors.

621.372.4 **2110**

Extension of a Theorem for Normal Passive Electrical Two-Poles in the Steady State.—L. Lunelli. (*Alta Frequenza*, June–Aug. 1960, Vol. 29, Nos. 3/4, pp. 377–388.) The theorem of R. M. Cohn (*Proc. Amer. Math. Soc.*, June 1950, Vol. 1, No. 3, pp. 316–324), which gives the terminal resistance of a two-pole network as a function of the resistances of its elements, is extended to allow for *n* degrees of freedom of the network satisfying the reciprocity condition.

621.372.4 : 681.142 **2111**

The Representation of Coupling-Free Branched Circuits on an Analogue Computer.—W. Schmieder. (*Arch. elekt. Übertragung*, Aug. 1960, Vol. 14, No. 8, pp. 327–334.) A method is given for simulating branched circuits on an analogue computer so that each circuit component can be varied independently to determine its effect on circuit characteristics. See also 3737 of 1960.

621.372.4 : 681.142 **2112**

Realization of Second-Order Two-Pole Functions with Transformerless Canonical Circuits by means of Program-Controlled Computers.—R. Unbehauen. (*Nachrichtentech. Z.*, July 1960 Vol. 13, No. 7, pp. 321–326.)

621.372.413 : 621.318.134 **2113**

The Size Effect of Ferrite Spheres.—W. Hauser & L. Brown. (*Quart. J. Mech. appl. Math.*, Aug. 1960, Vol. 13, Part 3, pp. 257–271.) The integral-equation technique is used to derive an approximate formula for the apparent susceptibility of a small ferrite sphere within a microwave cavity. Using a variational principle a first-order estimate is obtained for the effect of a plane wall and the effect of the size of the sphere. See 27 of 1960.

621.372.5 **2114**

Calculation of the Transfer Function from the Magnitude of the Transmission Factor.—G. Wunsch. (*Frequenz*, July 1960, Vol. 14, No. 7, pp. 244–247.) Generalization and modification of Küpfmüller's system theory to eliminate certain contradictions with practical systems.

621.372.5 **2115**

The Matrix of a Recurrent Network of Equal Quadripoles (Representation of Any Power of a Matrix).—G. Doetsch. (*Arch. elekt. Übertragung*, Aug. 1960, Vol. 14, No. 8, pp. 335–340.) An explicit expression is derived for the *n*-th power of a matrix representing *n* equal four-terminal networks in cascade.

621.372.54 **2116**

Synthesis of Electrical Filters from Operating Parameters by means of Zolotarëv Fractions.—A. F. Ufel'man. (*Radiotekhnika, Mosk.*, May 1960, Vol. 15, No. 5, pp. 64–72.) Design formulae are given in which special functions are avoided by using mathematical tables of Glowatzki (see 2051 of 1957) and which involve less calculation than is required using the Grossman formulae (2053 of 1957).

621.372.54 **2117**

Electrical Wave Filter with Prescribed Operating Characteristics.—J. B. Fischer. (*Arch. elekt. Übertragung*, July 1960, Vol. 14, No. 7, pp. 283–298.) Calculations are simplified by the application of image-parameter theory to filter design, which may outweigh the advantages of economy in circuit components resulting from the use of insertion-loss methods. Exact relations are derived between the quadripole and insertion-loss characteristics of reactance quadripoles, and examples are given.

621.372.54 **2118**

Gaussian-Response Filter Design.—M. Dishal. (*Elect. Commun.*, 1959, Vol. 36, No. 1, pp. 3–26.) Exact data are given for the design of both low- and band-pass filters having characteristics which are *n*th-order approximations to the perfect Gaussian amplitude response, *n* being the number of elements in the complete filter.

621.372.54 **2119**

General Low-Pass and High-Pass Antimetric Filters Inserted between Equal Resistances.—J. E. Colin. (*Câbles & Transm.*, Oct. 1960, Vol. 14, No. 4, pp. 262–269.)

621.372.54: 681.142 **2120**

The Application of Electronic Digital Computers in Network Theory.—H. Härtl. (*Nachrichtentech. Z.*, July 1960, Vol. 13, No. 7, pp. 313–316.) The applications discussed are (*a*) the synthesis of a quadripole reactance filter, and (*b*) network analysis.

621.372.54 + 621.372.57].029.42 **2121**

Filter Circuits for Extremely Low Frequencies without the Use of Inductances.—H. G. Jungmeister & H. L. König. (*Arch. elekt. Übertragung*, July 1960, Vol. 14, No. 7, pp. 317–324.) Description of filter-design procedure using double-*T RC* networks. Passive and active filter circuits are given.

621.372.543.2: 534.143 **2122**

Electromechanical Quadripoles as Coupling Filters.—E. Trzeba. (*Hochfrequenztech. u. Elektroakust.*, June 1960, Vol. 69, No. 3, pp. 108–117.) The equivalent circuits of mechanical resonators and electromechanical transducers are derived and the design of band-pass filters consisting of input and output electromechanical transducers coupled by a mechanical transmission line is described.

621.372.543.2: 621.372.412 **2123**

Ceramic I. F. Transformers.—R.C.V. Macario. (*Wireless World*, May 1961, Vol. 67, No. 5, pp. 253–256.) Discusses the principles of design of the radial-mode resonator as used in i.f. circuits. See 2124 below.

621.372.543.2: 621.372.412 **2124**

Design Data for Band-Pass Ladder Filters employing Ceramic Resonators.—R. C. V. Macario. (*Electronic Engng*, March 1961, Vol. 33, No. 397, pp. 171–177.) Graphical and tabulated design data based on image-parameter theory are given for filters comprising piezoelectric disks resonating in a radial mode with or without capacitors. The ranges of centre frequency, bandwidth and image impedance achievable are discussed.

621.373.029.6: 621.372.44 **2125**

An Analysis of the Magnetic Second-Subharmonic Oscillator.—A. Lavi & L. A. Finzi. (*Proc. Inst. Radio Engrs*, April 1961, Vol. 49, No. 4, pp. 779–787.) The analysis refers to a parametric oscillator with two ferromagnetic cores. The steady-state operation with both current and voltage pump drives is studied to determine the values of the circuit parameters which will give subharmonic oscillations. The experimental waveforms are close to those predicted.

621.373.42: 621.372.44 **2126**

Oscillator Circuits with Variable Parameters (Rheolinear Oscillators).—E. G. Woschni. (*Hochfrequenztech. u. Elektroakust.*, June 1960, Vol. 69, No. 3, pp. 103–108.) Approximation formulae are given for determining pull-in range and gain of parametric oscillators; sinusoidal variation of capacitance and of attenuation are the cases particularly considered. See also 3560 of 1956.

621.373.42.029.55: 621.396.933 **2127**

An Airborne Frequency Generating Unit for the H.F. Communication Band.—T. F. Hargreaves, J. H. Gifford & G. E. Smythe. (*J. Brit. Instn Radio Engrs*, Feb. 1961, Vol. 21, No. 2, pp. 129–136.) The unit gives an output frequency, with channel spacing of 1 kc/s, in the band 3·5–26·5 Mc/s. A variable oscillator is phase-locked to a frequency derived from a 5-Mc/s standard.

621.373.421.13 **2128**

Piezoelectric Excitation of Quartz Oscillators Operating in the Thickness Mode by means of a Parallel Field.—R. Bechmann. (*Arch. elekt. Übertragung*, Aug. 1960, Vol. 14, No. 8, pp. 361–365.) The parallel-field excitation of AT- and BT-cut crystals is considered and its advantages are discussed. Equivalent circuits are given of two experimental oscillators, for 750 kc/s and 1 Mc/s using AT-cut quartz crystal resonators. See also 3544 of 1960.

621.373.431.1 **2129**

Frequency Control and Frequency Fluctuations of the Astable Multivibrator.—G. Linckelmann. (*Arch. elekt. Übertragung*, July 1960, Vol. 14, No. 7, pp. 299–313.) A modified multivibrator circuit is given which permits frequency variation over the range 1:400 by means of grid bias control. The causes of fluctuations of pulse repetition frequency are investigated and design formulae are derived for minimizing these effects.

621.373.52 **2130**

High-Frequency Transistor Polyphase Oscillator.—T. Takagi & K. Mano. (*Sci. Rep. Res. Inst. Tohoku Univ., Ser. B*, 1960, Vol. 12, No. 1, pp. 27–39.) Conditions for oscillation of a polyphase transistor oscillator are developed from its valve equivalent (791 of March). Experimental results show the relative performances of single, polyphase, and push-pull transistor oscillators and demonstrate the superiority of the polyphase oscillator when a high power output is required at high frequencies.

621.374.4: 621.372.8 **2131**

Waveguide Harmonic Generators.—J. Brown. (*Proc. Inst. Radio Engrs*, April 1961, Vol. 49, No. 4, p. 825.) The generator suggested by Hedderley (4144 of 1960) is regarded as a multiphase rectifier circuit.

621.374.4: 621.396.62 **2132**

The Synthesis of High-Purity Oscillations Suitable for Single-Sideband Receivers.—P. S. Carnt & E. Ribchester. (*J. Brit. Instn Radio Engrs*, March 1961, Vol. 21, No. 3, pp. 237–240.) A phase-locked oscillator has its output mixed with part of a 100-kc/s spectrum to form an i.f. in the region 900–1 000 kc/s. An interpolating signal with unwanted components 40 dB down, is used to lock the loop. Frequencies at 1 kc/s intervals between 3 and 30 Mc/s are derived.

621.374.4.029.65 **2133**

Harmonic Generators for the 40 000-Mc/s Band.—L. Grifone. (*Ricerca sci.*, Aug. 1960, Vol. 30, No. 8, pp. 1214–1220.) Description of two signal generators covering the ranges 31–41 and 39–51 Gc/s. They incorporate a 9-Gc/s klystron oscillator and Si-diode frequency multipliers (665 of 1955).

621.375.221 **2134**

Increase of the Gain of a Wide-Band Distributed Amplifier by Compensation of its Zeros and by Arrangement of the Residual Poles in a Tchebycheff Ellipse.—J. Koch. (*Arch. elekt. Übertragung*, Aug. 1960, Vol. 14, No. 8, pp. 348–360.) A set of equations is obtained for a two-valve distributed amplifier and its component values and characteristics are calculated for a limiting frequency of 300 Mc/s. General formulae for distributed amplifiers with any number of valves are derived. Theoretical results are verified with the aid of an experimental two-valve circuit. The Tchebycheff-type of amplifier is shown to have a gain greater, by a factor of 1·84, than the conventional distributed amplifier.

621.375.4 **2135**

Bandpass Transistor Amplifiers.—C. J. McCluskey. (*Electronic Technol.*, May 1961, Vol. 38, No. 5, pp. 183–187.) A determinant method is given for the analysis of amplitude and phase responses of tuned amplifiers having complex internal feedback circuits.

621.375.9: 621.372.44 **2136**

A Wide-Band Single-Diode Parametric Amplifier using Filter Techniques.—A. G. Little. (*Proc. Inst. Radio Engrs*, April 1961, Vol. 49, No. 4, pp. 821–822.) An arrangement is described using parallel-tuned circuits at appropriate points along the signal line to give bandwidths up to 130 Mc/s at a centre frequency of 3·3 Gc/s.

621.375.9: 621.372.44 **2137**

A Nondegenerate S-Band Parametric Amplifier with Wide Bandwidth.—G. Schaffner & F. Voorhaar. (*Proc. Inst. Radio Engrs*, April 1961, Vol. 49, No. 4, pp. 824–825.) Band-pass filters in the input and idler circuits are used to give a bandwidth of 80 Mc/s at a centre frequency of 2·5 Gc/s. Operation in four different modes is possible.

621.375.9: 621.372.44 **2138**

A Nearly Optimum Wide-Band Degenerate Parametric Amplifier.—M. Gilden & G. L. Matthaei. (*Proc. Inst. Radio Engrs*, April 1961, Vol. 49, No. 4, pp. 833–834.) A double-resonator single-diode design with 3-dB bandwidth of 210 Mc/s centred on 1 Gc/s.

621.375.9: 621.372.44: 621.372.2 **2139**

Interpretation of the Transmission-Line Parameters with a Negative-Conductance Load and Application to Negative-Conductance Amplifiers.—Stelzried. (See 2076.)

621.375.9: 621.372.44: 621.385.6 **2140**

Behaviour of Thermal Noise and Beam Noise in a Quadrupole Amplifier.—R. Adler & G. Wade. (*Proc. Inst. Radio Engrs*, April 1961, Vol. 49, No. 4, p. 802.)

621.375.9: 621.382.23 **2141**

A Broad-Band Tunnel-Diode Amplifier.—N. F. Moody & A. G. Wacker. (*Proc. Inst. Radio Engrs*, April 1961, Vol. 49, No. 4, p. 835.) A first-order theory for an amplifier using tunnel diodes is presented. The series resistance and inductance of the diodes is

neglected except where stability is concerned. The amplifier could be built using strip or coaxial lines.

621.376.223 **2142**

Elimination of Even-Order Modulation in Rectifier Modulators.—D. G. Tucker. (*J. Brit. Instn Radio Engrs*, Feb. 1961, Vol. 21, No. 2, pp. 161–167.) The time-varying-resistance function of the modulator is considered not to be a square wave but to contain even-order carrier harmonics.

621.376.223 **2143**

The Relative Magnitudes of Modulation Products in Rectifier Modulators and some Effects of Feedback.—D. P. Howson. (*J. Brit. Instn Radio Engrs*, March 1961, Vol. 21, No. 3, pp. 275–281.) The various modulation products occurring in series, shunt and ring modulators are evaluated for square-wave switching of the rectifiers assuming that the terminations are resistive. The information is used in the design of feedback modulators.

621.376.33 **2144**

The Round-Travis Discriminator.—K. R. Sturley. (*Electronic Technol.*, May 1961, Vol. 38, No. 5, pp. 186–189.) A re-examination of Johnstone's analysis of the Round-Travis amplitude discriminator (1220 of 1957) shows that the conditions indicated are not those giving minimum distortion; a correction is proposed.

GENERAL PHYSICS

530.162: 621.391.822 **2145**

Thermal Noise in Dissipative Media.—H. A. Haus. (*J. appl. Phys.*, March 1961, Vol. 32, No. 3, pp. 493–500.) To account for the spontaneous thermal fluctuations in a general dissipative medium, a current-source term is introduced into Maxwell's equations. The results are applicable to nonuniform media and to media at nonuniform temperatures.

537.311.33 **2146**

Theory of Electron-Phonon Interactions.—G. D. Whitfield. (*Phys. Rev.*, 1st Feb. 1961, Vol. 121, No. 3, pp. 720–734.) "The theory of the interaction of electrons and acoustic phonons in nonpolar crystals has been formulated in terms of a new set of basis states, whose wave functions are essentially Bloch functions that deform with the lattice. The major part of the interaction may then be calculated in terms of the strain tensor rather than the displacement of the lattice. A result of the theory is a generalization of the deformation potential theorem."

537.525.72: 538.569 **2147**

A Gas Discharge Free in Space, Glowing at the Focus of a Radar Parabaloid.—J. Greek & H. Kleinwächter. (*Z. Phys.*, 16th Aug. 1960, Vol. 159, No. 4, pp. 370–383.) An electrodeless gas discharge in a low-pressure vessel was achieved using an arrangement of two paraboloidal mirrors and coherent e.m. radiation at 3 cm λ.

535.329: 537.311 **2148**

On the Relation between Zener Breakdown and Residual Resistance in Crystals.—P. Gosar. (*Nuovo Cim.*, 16th Oct. 1960, Vol. 18, No. 2, pp. 241–250. In English.) The theory of Zener breakdown in crystals is extended to the case of very strong electric fields.

537.533.8 **2149**

Energy Dissipation and Secondary Electron Emission in Solids.—H. Kanter. (*Phys. Rev.*, 1st Feb. 1961, Vol. 121, No. 3, pp. 677–681.) Experiments show a proportionality between secondary-electron yield and energy dissipation by incident electrons.

537.533.8 **2150**

Contribution of Back-Scattered Electrons to Secondary-Electron Formation.—H. Kanter. (*Phys. Rev.*, 1st Feb. 1961, Vol. 121, No. 3, pp. 681–684.) The contribution observed was large even in materials of low Z; it was 40% in Al for 10-keV electrons.

537.56 **2151**

Pulse Conduction in Decaying Plasma.—V. Arunasalam & J. D. Trimmer. (*Rev. sci. Instrum.*, March 1961, Vol. 32, No. 3, pp. 282–285.) Apparatus has been constructed in which plasma, ionized by 144-Mc/s r.f. excitation, is subjected to repeated submicrosecond voltage pulses immediately after excitation is removed; the current is measured.

537.56 **2152**

Generation and Measurement of Highly Ionized Quiescent Plasmas in Steady State.—R. C. Knechtli & J. Y. Wada. (*Phys. Rev. Lett.*, 1st March 1961, Vol. 6, No. 5, pp. 215–217.) A simple generation technique is described. Experimental results validate double-probe measurements, indicate purely ambipolar diffusion in homogeneous d.c. magnetic fields and give a recombination coefficient of Cs plasmas below 10^{-10} cm^3 sec^{-1}.

537.56 **2153**

Drift Velocities of Slow Electrons in Helium, Neon, Argon, Hydrogen and Nitrogen.—J. L. Pack & A. V. Phelps. (*Phys. Rev.*, 1st Feb. 1961, Vol. 121, No. 3, pp. 798–806.)

537.56: 537.533 **2154**

Electromagnetic Interaction of a Beam of Charged Particles with Plasma.—J. Neufeld & P. H. Doyle. (*Phys. Rev.*, 1st Feb. 1961, Vol. 121, No. 3, pp. 654–658.) The theory of growing plasma waves is generalized to include waves propagated in directions other than the beam direction.

537.56: 538.566 **2155**

A Method for Measuring High Electron Densities in Plasmas.—S. Takeda & M. Roux. (*J. phys. Soc. Japan*, Jan. 1961, Vol. 16, No. 1, pp. 95–98.) It is proposed that the standing-wave pattern produced by plane microwaves at the plasma boundary be measured to give the complex reflection coefficient which is related to the electron density and collision frequency.

537.56: 538.63 **2156**

Diffusion of Plasma across a Magnetic Field.—J. B. Taylor. (*Phys. Rev. Lett.*, 15th March 1961, Vol. 6, No. 6, pp. 262–263.)

537.56: 621.372.8 **2157**

The Influence of the Langmuir Stratum between Plasma and Container Wall on Wave Propagation in a Plasma Cable.—W. O. Schumann. (*Z. angew. Phys.*, July 1960, Vol. 12, No. 7, pp. 298–300.) See also 1121 of April.

538.12: 538.221 **2158**

Field External to Open-Structure Magnetic Devices Represented by Ellipsoid or Spheroid.—H. Chang. (*Brit. J. appl. Phys.*, April 1961, Vol. 12, No. 4, pp. 160–163.) Mathematical expressions for the fields are given and curves are plotted with dimensional ratio as parameter.

538.56: 537.56 **2159**

The Electromagnetic Fields of a Dipole in the Presence of a Thin Plasma Sheet.—J. R. Wait. (*Appl. sci. Res.*, 1960, Vol. B8, Nos. 5/6, pp. 397–417.) An extension of Poeverlein's work (3604 of 1958). Under the assumption that the thickness of the slab is small, expressions for the resultant fields are obtained. See also 2352 below.

538.566 **2160**

Impedance Boundary Conditions for Imperfectly Conducting Surfaces.—T. B. A. Senior. (*Appl. sci. Res.*, 1960, Vol. B8, Nos. 5/6, pp. 418–436.) It is shown how the exact e.m. boundary conditions at the surface of a material of large refractive index can be approximated to yield the usual impedance or Leontovich boundary conditions [see e.g. 1901 of 1947 (Leontovich & Fock)].

538.566 **2161**

Propagation of Electromagnetic Surface Waves along Wedge Surfaces.—W. E. Williams. (*Quart. J. Mech. appl. Math.*, Aug. 1960, Vol. 13, Part 3, pp. 278–284.) The conditions under which surface waves can be excited by a plane e.m. wave incident on a wedge are determined.

538.566 **2162**

Impedance Boundary Conditions for Statistically Rough Surfaces.—T. B. A. Senior. (*Appl. sci. Res.*, 1960, Vol. B8, Nos. 5/6, pp. 437–462.)

538.566: 535.42 **2163**

Scalar Diffraction by a Prolate Spheroid at Low Frequencies.—T. B. A. Senior. (*Canad. J. Phys.*, Dec. 1960, Vol. 38, No. 12, pp. 1632–1641.)

538.566: 535.43 **2164**

Scattering by a Narrow Unidirectionally Conducting Infinite Strip.—S. R. Seshadri. (*Canad. J. Phys.*, Dec. 1960, Vol. 38, No. 12, pp. 1623–1631.) Expressions for the far-zone fields and the first two terms in the series for the total scattering cross-section are obtained.

538.566: 535.43 **2165**

Back-Scattering from a Conducting Cylinder with a Surrounding Shell.—M. A. Pionus. (*Canad. J. Phys.*, Dec. 1960, Vol. 38, No. 12, pp. 1665–1676.)

538.566: 535.43 **2166**

Scattering by a Grating: Parts 1 & 2.—R. F. Millar. (*Canad. J. Phys.*, Jan. 1961, Vol. 39, No. 1, pp. 81–118.) Anomalies occur in the angular spectrum of plane waves scattered by a grating when any of the waves propagate tangentially along the surface. This behaviour is analysed theoretically for a wave function vanishing on the grating elements, and for the derivative of the wave function vanishing.

538.566: 537.56 **2167**

Nonlinear Interaction of an Electromagnetic Wave with a Plasma Layer in the Presence of a Static Magnetic Field: Part 1—Theory of Harmonic Generation.—R. F. Whitmer & E. B. Barrett. (*Phys. Rev.*, 1st Feb. 1961, Vol. 121, No. 5, pp. 661–668.) Theory of propagation through an anisotropic ionized layer, as a function of H, ω_p, ω, incident field strength, and layer thickness, is presented.

538.566.2 **2168**

Penetration of Microwaves into the Bases Medium in Total Reflection.—J. J. Brady, R. O. Brick & M. D. Pearson. (*J. opt. Soc. Amer.*, Nov. 1960, Vol. 50, No. 11, pp. 1080–1084.) Using right-angle prism separated by a narrow air gap, transmission and reflection coefficients of paraffin, sulphur and NaCl have been measured at 3 cm λ as a function of the gap width.

538.566.2 **2169**

Refraction and Diffraction of Pulses.—W. E. Williams. (*Canad. J. Phys.*, Feb. 1961, Vol. 39, No. 2, pp. 272–275.) A solution for reflection and refraction of a plane pulse at a plane surface is obtained by Fourier synthesis using a method which is also valid when total reflection occurs.

538.569.4: 535.853 **2170**

A Spectrometer for Paramagnetic Electron Resonance with Different Methods of Detection.—D. Bösnecker. (*Z. angew. Phys.*, July 1960, Vol. 12, No. 7, pp. 306–314.) The equipment described can be used for the klystron frequency-modulation and magnetic sweep methods of measurement.

538.569.4: 538.221 **2171**

Theory of Ferro- and Antiferromagnetic Resonance Absorption.—T. Oguchi & A. Honma. (*J. phys. Soc. Japan*, Jan. 1961, Vol. 16, No. 1, pp. 79–94.)

538.569.4: 538.221: 621.318.134 **2172**

Longitudinal Ferrimagnetic Resonance.—R. K. Wangsness. (*Phys. Rev.*, 15th Jan. 1961, Vol. 121, No. 2, p. 472.) Susceptibility components are calculated for a triangular ferrimagnetic system when the oscillating field is parallel to both the constant field and the net magnetization. See also 499 of February.

538.569.4: 538.221: 621.318.134 **2173**

The Relation of Transition Parameters for Linear Processes to Measurable Parameters in Ferrimagnetic Resonance.—P. E. Seiden. (*J. Phys. Chem. Solids*, Jan. 1961, Vol. 17, Nos. 3/4, pp. 259–266.) Calculated expressions include the effect of the reaction of spin waves back on to the uniform precession. The consequences of its neglect in previous calculations by others are discussed.

538.569.4: 621.375.9: 535.61-1.2 **2174**

Confocal Multimode Resonator for Millimetre through Optical Wavelength Masers.—G. D. Boyd & J. P. Gordon. (*Bell Syst. tech. J.*, March 1961, Vol. 40, No. 2, pp. 489–508.) The mode patterns and diffraction losses are obtained for a resonator formed by two concave spherical reflectors. These are shown to be a minimum when the reflector spacing equals the common radius of curvature of the reflectors. The optical alignment is not extremely critical.

538.569.4: 621.375.9: 535.61-2 **2175**

Resonant Modes in a Maser Interferometer.—A. G. Fox & T. Li. (*Bell Syst. tech. J.*, March 1961, Vol. 40, No. 2, pp. 453–488.) A theoretical investigation is made of the diffraction of e.m. waves in Fabry-Perot interferometers when used as resonators in optical masers. Curves for field distribution and diffraction loss are given for different mirror geometries and different modes.

539.2 **2176**

Collective Excitation of Electrons in Degenerate Bands: Part 2—Collective Excitations in a Metallic *p*-Band.—T. Izuyama. (*Prog. theor. Phys.*, Oct. 1960, Vol. 24, No. 4, pp. 899–907.) Part 1: 827 of March.

GEOPHYSICAL AND EXTRATERRESTRIAL PHENOMENA

523.164: 621.396.677 **2177**

The Radio Telescope for 7·9 Metres Wavelength at the Mullard Observatory.—C. H. Costain & F. G. Smith. (*Mon. Not. R. astr. Soc.*, 1960, Vol. 121, No. 4, pp. 405–412.) The pencil-beam system described is based on the principle of aperture synthesis and has a resolution of $0{\cdot}8° \times 0{\cdot}8°$. A survey of the sky between R.A.05^h and 17^h, declination $+10°$ to $+50°$ is given.

523.164.4 **2178**

The Radio Spectrum of the Andromeda Nebula.—J. E. Baldwin & C. H. Costain. (*Mon. Not. R. astr. Soc.*, 1960, Vol. 121, No. 4, pp. 413–417.) New observations have been made at 38 and 178 Mc/s. Results are compared with those made at Jodrell Bank at 408 Mc/s by Large et al. (2937 of 1959) and show that all parts of the nebula have a similar spectrum.

523.165 **2179**

Asymmetry in the Recovery from a Very Deep Forbush-Type Decrease in Cosmic-Ray Intensity.—D. C. Rose & S. M. Lapointe. (*Canad. J. Phys.*, Feb. 1961, Vol. 39, No. 2, pp. 239–251.) Analyses the intensity-time curve for cosmic rays recorded at 30 locations all over the world. Recovery occurred at each station at the same effective local time, corresponding to arrival from directions making 15° and 165° with the sun-earth line.

523.165: 523.75 **2180**

Cosmic-Ray Flare of November 16, 1960.—R. T. Hansen. (*Phys. Rev. Lett.*, 15th March 1961, Vol. 6, No. 6, pp. 260–262.) A solar flare was observed visually at a height at least 10^4 km above the chromosphere, during a period of increased cosmic-ray neutron flux and a burst in solar noise flux [1496 of May (Covington & Harvey)].

523.165: 550.385.6 **2181**

The Drift Velocity of Charged Particles in the Magnetic Dipole Field.—M. Siebert. (*Naturwissenschaften*, Aug. 1960, Vol. 47, No. 15, p. 351.) A more accurate expression for the drift velocity of particles in the vicinity of the equator is derived by allowing for a second centrifugal-force term in the original equation.

523.165: 550.385 **2182**

Equation of a Charged Particle Shell in a Perturbed Dipole Field.—R. M. Pennington. (*J. geophys. Res.*, March 1961, Vol. 66, No. 3, pp. 709–712.) The equation obtained agrees with the drift measured by satellite 1958 α following the nuclear explosion of 6th September 1958.

523.165: 550.385.4 **2183**

Effect of Hydromagnetic Waves in a Dipole Field on the Longitudinal Invariant.—E. N. Parker. (*J. geophys. Res.*, March 1961, Vol. 66, No. 3, pp. 693–708.) Hydromagnetic waves of period 1 sec and amplitude 10^{-2} G at 6 earth radii may cause a systematic lowering of mirror points with subsequent loss of particles in atmospheric collisions. Two models for electron density variation along a field line are investigated. Particle acceleration by the Fermi process is dominated by particle loss at mirror points, and it is suggested that only high-frequency waves will give effective acceleration. See also 533 of February.

523.165: 550.385.4 **2184**

Preliminary Report on Cosmic-Ray Intensity during Magnetic Storms in July 1959.—J. G. Roederer, O. R. Santochi, J. C. Anderson, J. M. Cardoso & J. R. Manzano. (*Nuovo Cim.*, 1st Oct. 1960, Vol. 18, No. 1, pp. 120–130. In English.) Observations at three stations show that there was no appreciable change in the primary variation spectrum for three successive Forbush decreases. This may be interpreted as an indication of a linear superposition of cosmic-ray modulation effects during the July disturbances. For an analysis of cosmic-ray intensity recorded at Mina Aguilar during this period as a function of time, see *ibid.*, pp. 131–135.

523.165: 550.385.4 **2185**

Cosmic-Ray Intensity Variations during the Magnetic Storm in May 1959.—J. R. Manzano, J. G. Roederer & O. R. Santochi. (*Nuovo Cim.*, 1st Oct. 1960, Vol. 18, No. 1, pp. 136–146. In English.)

The primary variation spectrum has been estimated in a similar manner to that used for the July storms (2184 above). Results for both storm periods have been compared, showing a number of common features.

523.3: 621.396.96 **2186**

Some Properties of Radio Waves Reflected from the Moon and their Relation to the Lunar Surface.—T. Hughes. (*J. geophys. Res.*, March 1961, Vol. 66, No. 3, pp. 777–783.) The properties of the echoes are described in terms of the correlation of the complex amplitudes of two sine waves at frequencies separated by $\Delta\omega$, reflected from the surface. The correlation technique can be extended to two-dimensional mapping of a rotating rough body. A statistical model of the lunar surface roughness is derived in which r.m.s. slopes of 1·20 to 1·50 are assumed.

523.3: 621.396.96 **2187**

A Method of Evaluating the Intensity of Radio Signals Reflected from the Surface of the Moon.—M. P. Dmitriyevskiy. (*Radiotekhn. Elektr.*, May 1960, Vol. 15, No. 5, pp. 1–6.) Propagation losses can be determined by supposing that the reflected wave is formed within the limits of the first Fresnel half-zone and taking account of the curvature of the reflecting surface. The method provides a more accurate picture of the reflection phenomena.

550.385 **2188**

Some Evidence of Hydromagnetic Waves in the Earth's Magnetic Field.—M. Sugiura. (*Phys. Rev. Lett.*, 15th March 1961, Vol. 6, No. 6, pp. 255–257.) Combining changes in the H and D components of field indicate that the horizontal magnetic vector is elliptically polarized. This may be due to a hydromagnetic wave travelling obliquely to the earth's magnetic field.

550.385 **2189**

Low-Latitude and High-Latitude Geomagnetic Agitation.—E. R. Hope. (*J. geophys. Res.*, March 1961, Vol. 66, No. 3, pp. 747–776.) Detailed study is made of geomagnetic agitation (ΔH). Above 60° the three daily maxima of ΔH have spigal loci. Agitation is an order of magnitude lower at middle latitudes increasing again towards the equator. Ionospheric current systems (with auroral electrojets) are examined in the above context. The occurrence frequency of sudden commencements at one station exhibits a diurnal variation. A recent theoretical explanation of this is examined. Over 100 references.

550.385.2 **2190**

On the Seasonal Variation in Lunar and Solar Geomagnetic Tides in the Geomagnetic Equatorial Region.—K. S. Raja Rao. (*J. atmos. terr. Phys.*, April 1961, Vol. 20, No. 4, pp. 289–294.)

550.385.4: 523.746 **2191**

Influence of Sunspots on Geomagnetic Disturbance.—F. Ward & R. Shapiro. (*J. geophys. Res.*, March 1961, Vol. 66, No. 3, pp. 739–746.) "The hypothesis that the ejection of solar corpuscles is influenced by interactions of 'active region' magnetic fields is tested empirically. The results do not support the hypothesis."

550.385.4: 551.594.5 **2192**

Dipole-Field Type Magnetic Disturbances and Auroral Activities.—B. K. Bhattacharyya. (*Canad. J. Phys.*, Feb. 1961, Vol. 39, No. 2, pp. 350–366.) The magnetic perturbation produced at the ground by the current system associated with an electric dipole at 100 km is calculated. Magnetograms obtained during an auroral display are analysed to deduce the position and motion of the equivalent dipole. These correspond closely to prominent visual auroral forms.

551.507.362.2 **2193**

Minimum Range to Artificial Earth Satellites.—K. Tomar. (*Nature, Lond.*, 22nd April 1961, Vol. 190, No. 4775, pp. 319–320.) A complete expression for calculating, from Doppler measurements, the minimum passing range between satellite and observer is derived, and its application under various orbital conditions is discussed.

551.507.362.2 **2194**

Loss of Mass in Echo Satellite.—L. L. Shapiro & H. M. Jones. (*Science*, 24th Feb. 1961, Vol. 133, No. 3452, p. 378.) Correction to 1157 of April and comparison of predictions with observed orbital data.

551.507.362.2 **2195**

Spin-Rate of the Satellite Echo 1 as Determined by a Tracking Radar.—G. C. G. Lockwood. (*Canad. J. Phys.*, 1961, Vol. 39, No. 12, p. 1713.) Radar observation of Echo 1 (1960 ι) indicate that between passes 131 and 217 the spin rate increased from 1·63 to 1·80 rev/min. Between these two observations the satellite first started passing into the earth's shadow, which possibly resulted in changes in internal pressure and subsequent deformation of the balloon.

551.507.362.2: 621.396.934 **2196**

New Satellite Tracking Station in Great Britain.—(See 2375.)

551.510.53 **2197**

Magnesium and Calcium Ions in the Upper Atmosphere of the Earth.—V. G. Istomin. (*Dokl. Ak. Nauk S.S.S.R.*, 11th Feb. 1961, Vol. 136, No. 5, pp. 1066–1068.) The presence of Mg^+ and Ca^+ ions was recorded by a rocket-borne mass spectrometer launched from a moderate latitude. Peaks in the Mg^+ ion concentration reaching $1{\cdot}36 \times 10^4/cm^3$ were observed at heights of 103·5 and 105 km.

551.510.53: 551.507.362 **2198**

Daytime and Nighttime Atmospheric Properties Derived from Rocket and Satellite Observations.—H. K. Kallmann-Bijl. (*J. geophys. Res.*, March 1961, Vol. 66, No. 3, pp. 787–795.) A summary of the values of atmospheric density obtained during the interval 1957–1960 from rockets and satellites is presented, and is fitted into a model atmosphere obtained by integrating the hydrostatic equation. A general decrease since 1957 in atmospheric density at all altitudes is confirmed.

551.510.535 **2199**

Rocket Electron Density Measurements at Fort Churchill, Canada.—A. W. Adey & W. J. Heikkila. (*Canad. J. Phys.*, Jan. 1961, Vol. 39, No. 1, pp. 219–221.) A discussion of the results of a rocket flight during quiet ionospheric conditions using the two-frequency phase-comparison technique of Seddon (803 of 1954).

551.510.535 **2200**

Longitudinal and Latitudinal Effect of the Ionosphere Estimated by Observation on Board the Soya.—H. Shibata, K. Sawada & S. Taguchi. (*J. Radio Res. Labs, Japan*, Nov. 1960, Vol. 7, No. 34, pp. 575–582.) Values of f_0F_2 at hourly intervals are plotted against geomagnetic latitude for the range 10°S–70°S covered by the voyages from Japan to Antarctica in December and January in 1956–1957, 1958–1959, 1959–1960.

551.510.535 **2201**

Ionization of E Layer by X Rays.—S. N. Ghosh & S. Nandi. (*Indian J. Phys.*, Nov. 1960, Vol. 34, No. 11, pp. 516–526.) The total amount of solar X-ray energy absorbed within the E layer is calculated from available rocket and absorption measurements. Only X rays in the wavelength region 5–100 Å are absorbed, the amount of energy involved being estimated as $0{\cdot}19\,erg\,cm^{-2}\,sec^{-1}$.

551.510.535 **2202**

Some Observations of the Occurrence and Movement of Sporadic-E Ionization.—J. Harwood. (*J. atmos. terr. Phys.*, April 1961, Vol. 20, No. 4, pp. 243–262.) An analysis of simultaneous observations of E_s clouds in Europe by ionosondes at various locations, by a 17-Mc/s rotating-aerial backscatter sounder at Slough, England, and by an oblique-propagation experiment at 17 Mc/s over 700 km. The mean cloud diameter was about 200 km. About twice as many clouds occurred to the south of Slough as to the north with an average duration of 2½ hours. Of 143 clouds, one third drifted, predominantly to the south-west, at a mean speed of 60 m/s. The movement of the clouds did not correlate with wind velocities.

551.510.535 **2203**

The F Layer at Sunrise.—H. Rishbeth & C. S. G. K. Setty. (*J. atmos. terr. Phys.*, April 1961, Vol. 20, No. 4, pp. 263–276.) Observations at Cambridge and Slough show that at fixed heights in the F region, just after layer sunrise, the electron density increases faster in winter than in summer, and faster at sunspot maximum than at sunspot minimum. It is postulated that seasonal changes of atmospheric composition alter the rates of electron production and loss, thereby causing both the 'noon' and 'sunrise' seasonal F_2-layer anomalies.

551.510.535 **2204**

Diffusion of Ionization in the Sunrise F Layer.—H. Rishbeth. (*J. atmos. terr. Phys.*, April 1961, Vol. 20, No. 4, pp. 277–288.) Some idealized calculations support the assumption made in 2203 above that the rate of increase of F-region electron density, just after sunrise, depends primarily on the rate of production of ionization. At this time the loss, diffusion and transport of ionization are of secondary importance.

551.510.535 **2205**

Travelling Disturbances in the F Region over Waltair.—E. B. Rao & B. R.

Rao. (*J. atmos. terr. Phys.*, April 1961, Vol. 20, No. 4, pp. 296–297.) A description is given of the general diurnal and seasonal characteristics of travelling disturbances as observed on $P'(t)$ and $P'(f)$ records extending over two years.

551.510.535: 523.164: 550.385.37 **2206**

Simultaneous Observations of Pulsations in the Geomagnetic Field and in Ionospheric Absorption.—S. Ziauddin. (*Canad. J. Phys.*, Dec. 1960, Vol. 38, No. 12, pp. 1714–1715.) On 20th and 21st September 1959 at 0700 L.M.T. regular pulsations were recorded simultaneously on (*a*) a riometer operating on a frequency of 34 Mc/s and (*b*) a magnetometer measuring the H component of the geomagnetic field. For many cycles the pulsations remain in phase but on occasions they are in antiphase. The period of the geomagnetic pulsations suggests that they are due to toroidal hydromagnetic oscillations of the outer atmosphere; possible connections with ionospheric absorption are briefly considered.

551.510.535: 523.745 **2207**

Analysis of the Variation of f_0E and Index of Solar Activity.—H. Shibata & S. Watanabe. (*J. Radio Res. Labs, Japan*, Nov. 1960, Vol. 7, No. 34, pp. 621–635.) It is assumed that, for both the diurnal and annual changes in f_0E, the critical frequency is proportional to $\cos^{1/4}\chi$. The values of f_0E are extrapolated to $\chi = 0$ for several stations and an empirical relation between the values for $\chi = 0$ and the sunspot number is derived.

551.510.535: 550.385 **2208**

Vertical Drift in the E Layer of the Ionosphere during Geomagnetic Disturbances.—H. Kohl. (*Arch. elekt. Übertragung*, July 1960, Vol. 14, No. 7, pp. 314–316.) The velocity is estimated of the vertical drift due to geomagnetic disturbances. The possible rise of the E layer is shown to be a few hundred metres only which cannot be measured by ionospheric recorders. For an investigation of F-layer movements see 1848 of June.

551.510.535: 621.3.087.4 **2209**

Active High-Frequency Spectrometers for Ionospheric Sounding: Part 1—Direct Recording of Ionospheric Characteristics.—K. Bibl. (*Arch. elekt. Übertragung*, Aug. 1960, Vol. 14, No. 8, pp. 341–347.) On the basis of the method noted earlier (2729 of 1956), equipment has been designed which provides direct records of M.U.F., h' and f_N as a function of time. Sample records are reproduced and applications of the method are discussed. A method of distinguishing height ranges in F-layer $f_N(t)$ records using colour film is noted.

551.510.535: 621.391.812.3 **2210**

Analysis of Random Fading Records.—Khastgir & Singh. (See 2357.)

551.510.535: 621.391.812.63 **2211**

Measurement of the Ionospheric Absorption during the I.G.Y. at Kokubunji.—J. Yasuda & H. Sugiuchi. (*J. Radio Res. Labs, Japan*, Nov. 1960, Vol. 7, No. 34, pp. 551–574.) The diurnal variation in absorption shows an asymmetry about noon which is attributed to the changes in vertical drift motion in the D layer associated with the *Sq* current system. The marked winter anomaly effect cannot be explained by a change in the electron density distribution in the normal *D* layer.

551.510.535: 621.391.812.63 **2212**

Ionospheric Motions Observed with High-Frequency Back-Scatter Sounders.—L. H. Tveten. (*J. Res. nat. Bur. Stand.*, March/April 1961, Vol. 65D, No. 2, pp. 115–127.) "Techniques for determining the characteristics of movements of irregularities in the F_2 region by the use of back-scatter records are described. The results of an analysis of back-scatter data obtained during December 1952, at Sterling, Virginia, at a frequency of about 13·7 Mc/s are presented and found to be in good agreement with those of other investigators of ionospheric motions."

551.510.535 **2213**
: 621.391.812.63.029.62/.63

Effect of the Magnetic Field in Ionospheric Back-Scatter.—E. E. Salpeter. (*J. geophys. Res.*, March 1961, Vol. 66, No. 3, pp. 982–984.) Back-scatter spectral lines may be used to calculate magnetic field, ion mass and plasma temperature. See also 1290 of April (Fejer).

551.510.535 (98): 621.391.812.631 **2214**

High-Frequency Radio-Wave Blackouts at Medium and High Latitudes during a Solar Cycle.—Collins, Jelly & Matthews. (See 2351.)

551.594.5 **2215**

Theory of Auroral Morphology.—J. W. Kern & E. H. Vestine. (*J. geophys. Res.*, March 1961, Vol. 66, No. 3, pp. 713–723.) The theory is based on the production of instabilities in electron sheets. It predicts observed features relating to the duration of homogeneous arcs and the transition from glow to homogeneous arcs to ray arcs and draperies. Other observations explained are certain phenomena in flaming aurorae and the lowering of mirror points in certain conditions.

551.594.5 **2216**

Reply to Some Comments by Malville concerning the Midnight Auroral Maximum.—E. H. Vestine & J. W. Kern. (*J. geophys. Res.*, March 1961, Vol. 66, No. 3, pp. 989–991.) The preponderance of aurora near magnetic midnight is discussed. See 149 of January (Malville).

551.594.5: 550.385.4 **2217**

The Relationship between Unique Geomagnetic and Auroral Events.—Y. Sobouti. (*J. geophys. Res.*, March 1961, Vol. 66, No. 3, pp. 725–737.) At eleven Canadian stations, a high correlation is found between the geomagnetic latitudes of the southern extents of aurorae and the most southerly current lines. A southward drift occurs simultaneously in an aurora and the accompanying ionospheric currents.

551.594.5: 551.510.535 **2218**

Relationship between Red Auroral Arcs and Ionospheric Recombination.—G. A. M. King & F. E. Roach. (*J. Res. nat. Bur. Stand.*, March/April 1961, Vol. 65D, No. 2, pp. 129–135.) An aurora arc (6 300 Å), observed photometrically to be north of Boulder, Colorado, has been identified with oblique echoes on ionograms taken near Boulder.

551.594.6 **2219**

Generation of Very-Low-Frequency Noise in the Exosphere by the Čerenkov Effect.—R. Gendrin. (*C. R. Acad. Sci., Paris*, 5th Sept. 1960, Vol. 251, No. 10, pp. 1122–1123.) The Čerenkov effect, produced by relatively slow-moving particles of solar origin, is considered as a possible mechanism for the generation and propagation of v.l.f. noise. The theory is briefly discussed in relation to a 'travelling-wave tube' model proposed by Gallet (1575 of 1959) to explain similar v.l.f. emissions.

551.594.6 **2220**

Energy Fluxes from the Cyclotron Radiation Model of V.L.F. Radio Emission.—W. B. Murcray & J. H. Pope. (*Proc. Inst. Radio Engrs*, April 1961, Vol. 49, No. 4, pp. 811–812.) Comment on a paper by Santirocco (4253 of 1960).

551.594.6 **2221**

Classification of the Waveforms of Atmospherics.—S. R. Khastgir & R. S. Srivastava. (*J. Instn Telecommun. Engrs, India*, Oct. 1960, Vol. 6, No. 6, pp. 260–265.) A review with 28 references.

551.594.6 **2222**

The Determination of the Distance of Atmospherics from their Waveform.—R. Schminder. (*Z. Met.*, July–Sept. 1960, Vol. 14, Nos. 7–9, pp. 212–217.) Diagrams facilitating the determination of the distance of atmospherics are given; their use is discussed with reference to the results of measurements. A reflection height of 70 km was assumed for daytime conditions, and 90 km for nighttime propagation.

551.594.6 **2223**

Guidance of Radio Whistlers by the Earth's Magnetic Field.—R. Gendrin. (*C. R. Acad. Sci., Paris*, 29th Aug. 1960, Vol. 251, No. 9, pp. 1085–1087.) In an anisotropic medium there is for each frequency an emission angle $\theta \neq 0$ of such a value that the ray propagates strictly along the line of magnetic force with a velocity which is independent of frequency.

551.594.6 **2224**

Remarks on the Annual and Diurnal Variations of the Occurrence of Whistlers.—L. Klinker & G. Entzian. (*Z. Met.*, July–Sept. 1960, Vol. 14, Nos. 7–9, pp. 207–212.) The annual variation of whistler density observed at Kühlungsborn appears to be correlated with the thunderstorm activity of South Africa and not with that of the conjugate point which is at a higher geomagnetic latitude. Nocturnal variations of whistler density show phase differences between summer and winter, which are attributed to absorption in the lower ionosphere.

551.594.6 **2225**

The Hydrogen Ion Effect in Whistler Dispersion.—R. E. Barrington & T.

Nishizaki. (*Canad. J. Phys.*, Dec. 1960, Vol. 38, No. 12, pp. 1642–1653.) Careful analysis of four low-altitude whistlers shows deviations at low frequencies from the law $tf^{\frac{1}{2}} = \text{const}$. This observation is explained in terms of a simple atmospheric model in which the gas above about 1 000 km is mainly hydrogen.

551.594.6: 621.3.087.4 **2226**

Initial Results of a New Technique for Investigating Sferic Activity.—G. Hefley, R. H. Doherty & R. F. Linfield. (*J. Res. nat. Bur. Stand.*, March/April 1961, Vol. 65D, No. 2, pp. 157–166.) The system was developed for the automatic measurement of the complex spectral characteristics and for the automatic high-speed processing of statistical data. Typical results are presented and discussed.

LOCATION AND AIDS TO NAVIGATION

534.88 **2227**

Prospects and Limitations of the Use of Low Frequencies in Echo Location.—G. Pazienza. (*Alta Frequenza*, June–Aug. 1960, Vol. 29, Nos. 3/4, pp. 323–336.) The frequency dependence is investigated of the parameters which determine the range of underwater echo-location equipment. The ranges obtainable at frequencies between 2 and 30 kc/s are calculated, and the problem of noise interference is discussed.

621.396.96: 621.375.9: 621.372.44 **2228**

Radar Sensitivity with Degenerate Parametric Amplifier Front End.—J. C. Greene & W. D. White: R. Adler. (*Proc. Inst. Radio Engrs*, April 1961, Vol. 49, No. 4, pp. 804–807.)

621.396.962.3: 621.372.54 **2229**

General Matched-Filter Analysis of Linear F.M. Pulse Compression.—C. E. Cook. (*Proc. Inst. Radio Engrs*, April 1961, Vol. 49, No. 4, p. 831.) Extension of earlier work (2023 of 1960).

621.396.963: 621.396.65 **2230**

Remote Presentation of Radar Information.—G. N. S. Taylor. (*Point to Point Telecommun.*, Feb. 1961, Vol. 5, No. 2, pp. 18–27.) The use of microwave links is discussed.

621.396.969.36 **2231**

Proposed Monocycle-Pulse Very-High-Frequency Radar for Airborne Ice and Snow Measurement.—J. C. Cook. (*Commun. & Electronics*, Nov. 1960, No. 51, pp. 588–594. Discussion.) A method is proposed for investigating from the air the thickness of ice and snow masses. The system, operating at about 100 Mc/s would radiate a single wave train from a spark gap, with the charge conductors shaped to encourage radiation of all frequency components in the spectrum of a short pulse.

MATERIALS AND SUBSIDIARY TECHNIQUES

531.788.7 **2232**

Hot-Cathode Magnetron Ionization Gauge for the Measurement of Ultra High Vacua.—J. M. Lafferty. (*J. appl. Phys.*, March 1961, Vol. 32, No. 3, pp. 424–434.) To extend the low pressure limit, an increase in the ratio of ion current to X-ray photocurrent is necessary. A magnetron gauge is discussed which is linear down to a pressure of 4×10^{-14} mm Hg.

533.583: 621.385.832 **2233**

The Determination of the Quantity of Barium Evaporated from Getters.—P. Della Porta & S. Origlio. (*Le Vide*, Nov./Dec. 1960, Vol. 15, No. 90, pp. 446–455. In French and English.) The complexometric method described is applied in the determination of the distribution of Ba on the screen of a television tube when using different shapes of getter.

535.215 **2234**

Effect of Photoexcitation on the Mobility in Photoconducting Insulators.—R. H. Bube & H. E. MacDonald. (*Phys. Rev.*, 15th Jan. 1961, Vol. 121, No. 2, pp. 473–483.) The Hall mobility of carriers in photoconducting insulators can be varied over an appreciable range by the effects of photoexcitation. Suitable use of the phenomena leads to knowledge about carrier density, sign and mobility and also gives information about the charge on and the cross section of the imperfection centres. Experiments on CdS and CdSe single crystals with conductivities in the range 10^{-8}–10^{-1} mho/cm illustrate the potentialities of the technique.

535.215: 546.28 **2235**

Some Preliminary Experiments Concerning the Influence of Band Bending on Photoelectric Emission.—J. J. Scheer. (*Philips Res. Rep.*, Dec. 1960, Vol. 15, No. 6, pp. 584–586.) "The theory that p-type semiconductors should exhibit a higher photoelectric quantum efficiency than n-type semiconductors is verified by measurements of the photoemission from cesium-covered silicon surfaces."

535.215: 546.48'221 **2236**

Cadmium Sulphide Photoconductive Sintered Layers.—M. J. B. Thomas & E. J. Zdanuk. (*J. electrochem. Soc.*, Nov. 1959, Vol. 106, No. 11, pp. 964–971.) Dependence of photoconduction characteristics on the composition and formation of layers is investigated.

535.215: 546.48'221 **2237**

The Effect of Mechanical Surface Treatment on the Fine Structure of the Spectral Curves of Photoconductivity in Cadmium Sulphide Crystals.—E. F. Gross & B. V. Novikov. (*Fiz. Tverdogo Tela*, Dec. 1959, Vol. 1, No. 12, pp. 1802–1805.)

535.215: 546.48'221 **2238**

The Change of the Real Structure of CdS Single Crystals due to the Evaporation of Lattice Constituents in a Vacuum.—K. W. Böer, H. Hornung & K. Zimmermann. (*Mber. dtsch. Akad. Wiss. Berlin*, 1960, Vol. 2, Nos. 3/4, pp. 159–161.) Report of heat-treatment tests on high-purity CdS crystals. Evaporation of Cd was observed at 380°C.

535.215: 546.48'221 **2239**

Influence of a Hydrogen Atmosphere on the Photoconduction of CdS Single Crystals.—M. Asche & F. Eckart. (*Mber. dtsch. Akad. Wiss. Berlin*, 1960, Vol. 2, No. 5, pp. 261–266.)

535.215: 546.48'221 **2240**

Remarks on the Photoconduction of CdS Single Crystals with Excitation at the Fundamental Lattice Absorption Edge.—H. Gutjahr. (*Mber. dtsch. Akad. Wiss. Berlin*, 1960, Vol. 2, No. 5, pp. 269–271.)

535.215: 546.48'221 **2241**

The Influence of Annealing in Vacuum and in Sulphur Vapour on the Real Structure of CdS Single Crystals.—K. W. Böer, H. Gutjahr & H. Hornung. (*Z. Phys.*, 25th Aug. 1960, Vol. 159, No. 5, pp. 495–504.) Investigations of the spectral distribution of photoconductivity [see also 1190 of April (Berger et al.)].

535.215: 546.48'221 **2242**

Photoconductivity of CdS-Type Photoconductors in the Vicinity of the Absorption Edge.—N. N. Winogradoff. (*J. appl. Phys.*, March 1961, Vol. 32, No. 3, pp. 506–509.) A new model for the photoconductivity mechanism is discussed.

535.215: 546.48'221: 538.63 **2243**

The Influence of Temperature and Ambient Conditions on the Photoelectromagnetic (PEM) Effect in CdS.—J. Auth. (*J. Phys. Chem. Solids*, Feb. 1961, Vol. 18, Nos. 2/3, pp. 261–262. In German.)

535.215: 546.817'231 **2244**

The Preparation of Vapour-Deposited Lead Selenide Films of High Mechanical and Electrical Stability.—H. Gobrecht, F. Niemeck & K. E. Boeters. (*Z. Phys.*, 25th Aug. 1960, Vol. 159, No. 5, pp. 533–540.)

535.376: 546.47'221 **2245**

Electroluminescence — a Disorder Phenomenon.—D. W. G. Ballentyne. (*J. electrochem. Soc.*, Oct. 1960, Vol. 107, No. 10, pp. 807–810.) Experimental investigations show that electroluminescence only occurs in ZnS powders containing both sphalerite and wurtzite. This observation suggests that electroluminescence is a disorder phenomenon associated with stacking faults in the crystal.

535.376: 546.47'221 **2246**

The Action of Nickel and Cobalt in Electroluminescent Zinc Sulphide Phosphors.—P. Goldberg. (*J. electrochem. Soc.*, Nov. 1959, Vol. 106, No. 11, pp. 948–954.) Luminescence characteristics are studied as a function of voltage, frequency, and concentration of Ni and Co. See also 2082 of 1956 (Lehmann: Haake).

537.226.8 **2247**

The Temperature Dependence of Dielectric Constants.—E. E. Havinga. (*J. Phys. Chem. Solids*, Feb. 1961, Vol. 18, Nos. 2/3, pp. 253–255.) For isotropic and for cubic materials three factors contribute to the temperature dependence: the influences of volume expansion and of temperature on polarizability, and a direct volume-expansion effect. A simple method is given for determining the values of the separate contributions.

537.227 **2248**

Contribution to the Theory of Ferro- and Antiferro-electrics.—V. I. Klyachkin. (*Fiz. Tverdogo Tela*, Dec. 1959, Vol. 1, No. 12, pp. 1874–1877.)

537.227: 546.431'824-31 **2249**

Quantitative Study of Low-Frequency Hysteresis Loops of Polarized Polycrystalline Barium Titanate.—G. W. Marks & D. A. Hanna. (*Commun. & Electronics*, Jan. 1961, No. 52, pp. 799–808.)

537.227: 547.476.3 **2250**

Measurement of the Dielectric Non-linearity of Rochelle Salt.—H. E. Müser. (*Z. angew. Phys.*, July 1960, Vol. 12, No. 7, pp. 300–306.) Discrepancies between measured values of coercivity and those predicted by the theory of the dielectric properties of Rochelle salt are investigated with reference to ferroelectric hysteresis measurements (3008 of 1959).

537.227: 547.476.3 **2251**

The Origin of the Optical Representation of the Ferroelectric Domains of Rochelle Salt Crystals.—H. Flunkert. (*Z. Phys.*, 15th July 1960, Vol. 159, No. 3, pp. 253–271.) A quantitative interpretation of observed interference effects is given, and an appropriate domain model is proposed.

537.228.1: 546.431'824-31 **2252**

Effect of Pressure on the Piezoelectric Properties of Barium Titanate.—B. A. Rotenberg. (*Fiz. Tverdogo Tela*, Dec. 1959, Vol. 1, No. 12, pp. 1777–1781.)

537.228.1: 546.431'824-31 **2253**

The Depolarization Charge of Barium Titanate and its Connection with the Piezoelectric Effect.—F. I. Kolomoitsev & I. A. Izhak. (*Fiz. Tverdogo Tela*, Dec. 1959, Vol. 1, No. 12, pp. 1791–1793.) The sign of the surface charge during depolarization always corresponds to the sign of the piezoelectric charge during compression. The charge released during heating near the Curie point is directly proportional to the size of the piezoelectric modulus.

537.228.1: 549.514.51 **2254**

Piezoelectric Behaviour of Impacted Quartz.—R. A. Graham. (*J. appl. Phys.*, March 1961, Vol. 32, No. 3, p. 555.)

[537.311.31 + 537.312.62]: 538.632 **2255**

Frequency-Dependent Hall Effect in Normal and Superconducting Metals.—P. B. Miller. (*Phys. Rev.*, 15th Jan. 1961, Vol. 121, No. 2, pp. 435–450.) Calculations are made of the Hall current flow when an e.m. wave is incident on the metal in a static magnetic field. The entire frequency range is considered, with emphasis on the microwave region.

537.311.33 **2256**

Recombination of Charge Carriers in Semiconductors with Any Concentration of Recombination Centres.—K. Thiessen. (*Mber. dtsch. Akad. Wiss. Berlin*, 1960, Vol. 2, Nos. 3/4, pp. 149–158.) Calculations of lifetimes are based on the existence of two trapping levels.

537.311.33 **2257**

Disturbances of Carrier Concentration in High Electric Field.—E. M. Conwell. (*J. Phys. Chem. Solids*, Jan. 1961, Vol. 17, Nos. 3/4, pp. 342–344.) Consideration of recombination of hot carriers on the basis of the Shockley-Read model for thermal carriers (420 of 1953) leads to a prediction of changes in carrier concentration occurring as a bulk effect in high fields.

537.311.33 **2258**

Decay of Excess Carriers in Semiconductors: Part 2.—K. C. Nomura & J. S. Blakemore. (*Phys. Rev.*, 1st Feb. 1961, Vol. 121, No. 3, pp. 734–740.) Theory of recombination of excess carriers, for large or small excess carrier densities, is presented for the case in which the trapping level and Fermi level lie in opposite halves of the intrinsic gap. Part 1: 1915 of 1959.

537.311.33 **2259**

Physical Properties of Several II-V Semiconductors.—W. J. Turner, A. S. Fischler & W. E. Reese. (*Phys. Rev.*, 1st Feb. 1961, Vol. 121, No. 3, pp. 759–767.) Energy gaps and mobilities have been measured in Zn_3As_2, $ZnAs_2$, ZnSb, Cd_3As_2, $CdAs_2$ and CdSb. For $CdAs_2$ the resistivity and mobility anisotropy have also been investigated.

537.311.33 **2260**

Composition Stability Limits of Binary Semiconductor Compounds.—R. F. Brebrick. (*J. Phys. Chem. Solids*, Feb. 1961, Vol. 18, Nos. 2/3, pp. 116–128.)

537.311.33 **2261**

Extended Curves of the Space Charge, Electric Field, and Free Carrier Concentration at the Surface of a Semiconductor, and Curves of the Electrostatic Potential Inside a Semiconductor.—C. E. Young. (*J. appl. Phys.*, March 1961, Vol. 32, No. 3, pp. 329–332.) The work of Kingston & Neustadter (3300 of 1955) has been extended and curves are given which apply to materials of higher energy gap. Curves of e.s. potential inside a semiconductor supplement those given by Dousmanis & Duncan (948 of 1959).

537.311.33: 538.569.4 **2262**

Cyclotron and Paramagnetic Resonance in Strained Crystals.—G. E. Pikus & G. L. Bir. (*Phys. Rev. Lett.*, 1st Feb. 1961, Vol. 6, No. 3, pp. 103–105.) Possible applications of resonance measurements on strained crystals are discussed, in particular the determination of the ratio of deformation potentials, investigation of semiconductors with toroidal energy surfaces, and the observation of spin resonance of free carriers in *p*-type Ge and Si.

537.311.33: 546.23 **2263**

The Influence of Tl and TlCl Impurities on the Conductivity and Photoconductivity of Selenium.—I. P. Shapiro. (*Fiz. Tverdogo Tela*, Dec. 1959, Vol. 1, No. 12, pp. 1782–1785.)

537.311.33: 546.24 **2264**

Magnetic Susceptibility and Galvanomagnetic Effects in Pure and *p*-Type Tellurium.—G. Fischer & F. T. Hedgcock. (*J. Phys. Chem. Solids*, Jan. 1961, Vol. 17, Nos. 3/4, pp. 246–253.) Experimental studies between 4·2 and 500 °K are described and the results discussed.

537.311.33: [546.28 + 546.289 **2265**

The Influence of Deformation of the Electrical Properties of *p*-Germanium and Silicon.—G. E. Pikus & G. L. Bir. (*Fiz. Tverdogo Tela*, Dec. 1959, Vol. 1, No. 12, pp. 1828–1840.) Based on expressions derived earlier (4285 of 1960) a quantitative theory is developed and the changes in conductivity, Hall coefficient and magnetoresistance during uniform deformation are calculated. See 1657 of 1960 (Pikus).

537.311.33: [546.28 + 546.289 **2266**

Segregation and Distribution of Impurities in the Preparation of Germanium and Silicon.—J. Goorissen. (*Philips tech. Rev.*, 7th June 1960, Vol. 21, No. 7, pp. 185–195.) Two variants of the zone-melting technique are described which yield a product in which the concentration of the impurity is uniformly distributed.

537.311.33: 546.28 **2267**

Thermal Expansion of Silicon at Low Temperatures.—S. I. Novikova & P. G. Strelkov. (*Fiz. Tverdogo Tela*, Dec. 1959, Vol. 1, No. 12, pp. 1841–1843.)

537.311.33: 546.28 **2268**

Recombination Radiation from Silicon under Strong-Field Conditions.—L. W. Davies & A. R. Storm, Jr. (*Phys. Rev.*, 15th Jan. 1961, Vol. 121, No. 2, pp. 381–387.) In an attempt to determine the distribution in energy of hot electrons and holes in Si placed in a strong electric field, measurements have been made of the spectral distribution of recombination radiation. The results indicate that intrinsic recombination radiation arises mainly from the decay of excitons rather than from direct recombination of electrons and holes.

537.311.33: 546.28 **2269**

Impurity Conduction in Silicon.—R. K. Ray & H. Y. Fan. (*Phys. Rev.*, 1st Feb. 1961, Vol. 121, No. 3, pp. 768–779.) Various *n*- and *p*-type Si samples of low impurity content were studied, and conduction due to charge exchange between impurity centres which may be ionized by some compensating impurity was observed. The results are compared with current theories.

537.311.33: 546.28 **2270**

Impact Ionization of Impurities in Silicon.—J. C. Irvin. (*J. Phys. Chem.*

Solids, Feb. 1961, Vol. 18, Nos. 2/3, pp. 181–195. In French.) Above a certain value of electric field impact ionization multiplies by avalanche. This phenomenon has been observed in Ge, InP and Si. Experimental data for *n*- and *p*-type Si are given.

537.311.33: 546.28 **2271**

Residual Thermoelastic Stresses in Bonded Silicon Wafers.—T. D. Rinery. (*J. appl. Phys.*, March 1961, Vol. 32, No. 3, pp. 456–460.) Stresses are investigated photoelastically. Methods normally employed with isotropic birefringent materials can be used.

537.311.33: 546.28 **2272**

Excess Tunnel Current in Silicon Esaki Junctions.—A. G. Chynoweth, W. L. Feldmann & R. A. Logan. (*Phys. Rev.*, 1st Feb. 1961, Vol. 121, No. 3, pp. 684–694.) The unexpectedly high excess current flow in Esaki junctions, when a medium forward bias is applied, has been studied experimentally. The results can be accounted for by a mechanism suggested by Yajima & Esaki (1257 *of* 1959), and an expression is derived for the excess current.

537.311.33: 546.281'26: 537.583 **2273**

Electron-Emission-Microscope and Velocity-Distribution Studies on Silicon Carbide *p-n* Junction Emitters.—P. H. Gleichauf & V. Ozarow. (*J. appl. Phys.*, March 1961, Vol. 32, No. 3, pp. 549–550.)

537.311.33: 546.289 **2274**

Temperature Dependence of the Low-Frequency Fluctuations of Conductivity in Germanium.—M. I. Kornfel'd & D. N. Mirlin. (*Fiz. Tverdogo Tela*, Dec. 1959, Vol. 1, No. 12, pp. 1866–1868.) The results of measurements at temperatures between −20 and + 100°C show that conductivity fluctuations in impure crystals are due to intrinsic conduction and are related to the generation and recombination of electron-hole pairs.

537.311.33: 546.289 **2275**

The Electrical Properties of Semiconductor Grain Boundaries.—H. A. Schell & H. F. Mataré. (*Z. Metallkde*, Jan. 1961, Vol. 52, No. 1, pp. 86–91.) Measurements of electrical characteristics were made at medium-tilt grain boundaries in oriented-growth Ge crystals. Devices based on grain-boundary effects are mentioned.

537.311.33: 546.289 **2276**

Resistivity Striations in Germanium Single Crystals.—H. Ueda. (*J. phys. Soc. Japan*, Jan. 1961, Vol. 16, No. 1, pp. 61–66.) The relation shown to exist between the period of the striations, growth rate and temperature gradient near the solid/liquid interface is explained by assuming a supercooled state in the crystallizing solid/liquid interface.

537.311.33: 546.289 **2277**

Theory of the Magnetic Susceptibility of Holes in Germanium.—J. M. Luttinger & P. J. Stiles. (*J. Phys. Chem. Solids*, Jan. 1961, Vol. 17, Nos. 3/4, pp. 284–291.) "The theory of the magnetic susceptibility of free holes is given. A general method of calculation which will work for degenerate as well as simple bands is described, and applied to the valence band of Ge. Results are given for both Maxwell-Boltzmann and Fermi-Dirac statistics, and the possibility of comparison with experiments is discussed."

537.311.33: 546.289 **2278**

Electron-Hole Scattering and Minority-Carrier Mobility in Germanium.—T. P. McLean & E. G. S. Paige. (*J. Phys. Chem. Solids*, Feb. 1961, Vol. 18, Nos. 2/3, pp. 139–148.) An extension of earlier work by Paige (1367 *of* May) by the specific application of the theory to Ge in the temperature and impurity concentration ranges where measurements of the minority-carrier mobility have been made.

537.311.33: 546.289 **2279**

Diffusion of Silver, Cobalt and Iron in Germanium.—L. Y. Wei. (*J. Phys. Chem. Solids*, Feb. 1961, Vol. 18, Nos. 2/3, pp. 162–174.)

537.311.33: 546.289 **2280**

Recombination of Excess Carriers at Twin Structures in Germanium.—J. P. McKelvey. (*J. appl. Phys.*, March 1961, Vol. 32, No. 3, pp. 442–445.) The continuity equation is solved for recombination of excess carriers at twin structures. The twin boundary recombination velocity is determined from lifetime measurements.

537.311.33: 546.289 **2281**

Relation between Surface Concentration and Average Conductivity in Diffused Layers in Germanium.—D. B. Cuttriss. (*Bell Syst. tech. J.*, March 1961, Vol. 40, No. 2, pp. 509–521.) An expression is derived for the average conductivity of a diffused layer in semiconductor material as a function of the surface concentration of the diffused impurity and the background impurity concentration.

537.311.33: 546.289: 539.12.04 **2282**

Change of Surface State of Ge by Electron Bombardment.—K. Komatsubara. (*J. phys. Soc. Japan*, Jan. 1961, Vol. 16, No. 1, pp. 125–126.) Changes are deduced from observed variations of reverse current.

537.311.33: 546.289: 539.23 **2283**

Hall Effect and Conductivity of Thin Vapour-Deposited Germanium Films.—F. Eckart & G. Jungk. (*Mber. dtsch. Akad. Wiss. Berlin*, 1960, Vol. 2, No. 5, pp. 266–269.) Preliminary report and discussion of Hall-effect and conductivity measurements on films of thickness 800–4 100 Å at magnetic field strengths up to 10 kG.

537.311.33: 546.289: 539.23 **2284**

The Low-Temperature Interaction of Oxygen with Evaporated Germanium Films.—M. J. Bennett & F. C. Tompkins. (*Proc. roy. Soc.*, 22nd Nov. 1960, Vol. 259, No. 1296, pp. 28–44.)

537.311.33: 546.289-31 **2285**

Donor Equilibria in the Germanium-Oxygen System.—C. S. Fuller, W. Kaiser & C. D. Thurmond. (*J. Phys. Chem. Solids*, Jan. 1961, Vol. 17, Nos. 3/4, pp. 301–307.) A more detailed account of work reported earlier (1229 *of* April). Donor formation has been investigated over a wide temperature range in Ge single crystals with well-defined oxygen concentrations. Results confirm that four oxygen atoms are involved in the formation of one donor.

537.311.33: 546.33'98 **2286**

A New Intermetallic Semiconductor Compound.—Ya. A. Ugai & T. N. Vigutova. (*Fiz. Tverdogo Tela*, Dec. 1959, Vol. 1, No. 12, pp. 1786–1788.) A note on the preparation and properties of NaSb with a band gap of 0·02 eV.

537.311.33: 546.681'811'19 **2287**

Preparation and Properties of $CdSiAs_2$.—A. J. Strauss & A. J. Rosenberg. (*J. Phys. Chem. Solids*, Jan. 1961, Vol. 17, Nos. 3/4, pp. 278–283.) Infrared transmission measurements indicate that the energy gap is about 0·23 eV at room temperature. The absorption edge shifts to shorter wavelengths with increasing electron concentration.

537.311.33: 546.681'86 **2288**

Optical Determination of the Conduction Band Structure of GaSb.—M. Cardona. (*J. Phys. Chem. Solids*, Jan. 1961, Vol. 17, Nos. 3/4, pp. 336–338.)

537.311.33:(546.682'19 + 546.681'19 **2289**

Electron Effective Masses of InAs and GaAs as a Function of Temperature and Doping.—M. Cardona. (*Phys. Rev.*, 1st Feb. 1961, Vol. 121, No. 3, pp. 752–758.) Faraday rotation and infrared reflectivity measurements were used.

537.311.33: 546.682'19 **2290**

Observation of Oscillatory Magnetoresistance in InAs at Microwave Frequencies.—G. Benski & B. Szymanski. (*J. Phys. Chem. Solids*, Jan. 1961, Vol. 17, Nos. 3/4, pp. 335–336.) Experimental technique and results are described and advantages of microwave measurements over d.c. measurements are discussed. Similar oscillations have been observed in InSb.

537.311.33: 546.682'19: 538.639 **2291**

Magnetothermal Nernst-Ettingshausen Effects in Indium Arsenide.—O. V. Emel'yanenko, N. V. Zotova & D. N. Nasledov. (*Fiz. Tverdogo Tela*, Dec. 1959, Vol. 1, No. 12, pp. 1868–1871.) Graphs show the variation of the Nernst-Ettingshausen coefficients of *n*-type InAs with temperature up to 600°K. With increase of electron density the point at which the transverse and longitudinal coefficients change sign is displaced towards lower temperatures.

537.311.33: 546.682'86 **2292**

Growth Twins in Indium Antimonide.—R. K. Mueller & R. L. Jacobson. (*J. appl. Phys.*, March 1961, Vol. 32, No. 3, pp. 550–551.)

537.311.33: 546.682'86 **2293**

Preparation and Properties of Grown *p-n* Junctions of InSb.—H. C. Gorton, A. R. Zacaroli, F. J. Reid & C. S. Peet. (*J. electrochem. Soc.*, April 1961, Vol. 108, No. 4, pp. 354–356.) Grown *p-n* junctions were produced by doping high-purity *n*-type melts with Zn. The curves of current density as a function of temperature

showed that leakage currents predominate at lower temperatures and saturation currents at higher temperatures.

537.311.33: 546.682'86'241 **2294**

A New Semiconducting Compound in the In-Sb-Te System.—N. A. Goryunova, S. I. Radautsan & G. A. Kiose. (*Fiz. Tverdogo Tela*, Dec. 1959, Vol. 1, No. 12, pp. 1858–1860.) A note on the physico-chemical properties of five InSb-InTe alloys, in particular In_4SbTe_3, a semiconductor.

537.311.33: 546.817'231 **2295**

Electrical Properties of Sb-Doped n-Type InAs.—J. Umeda. (*J. phys. Soc. Japan*, Jan. 1961, Vol. 16, No. 1, p. 178.)

537.311.33: 547.583 **2296**

Current/Voltage Characteristics of the Autoelectron Current from Semiconductors.—Yu. V. Zubenko, A. K. Klimin & I. L. Sokol'skaya. (*Fiz. Tverdogo Tela*, Dec. 1959, Vol. 1, No. 12, pp. 1845–1847.) A note on field-emission data for W_2C and Ge at variance with other published data [see *e.g.* 1922 of 1959 (Gofman et al.)].

537.311.33: 621.317.3 **2297**

A Thermal Shutter Phenomenon in Field-Effect Measurements.—N. B. Grover & Y. Goldstein. (*J. Phys. Chem. Solids*, Jan. 1961, Vol. 17, Nos. 3/4, pp. 338–340.) The phenomenon may lead to misinterpretation of field-effect data taken on samples whose temperature differs from that of their surroundings. The nature of the thermal shutter depends only on the mounting of the sample.

537.311.33: 621.375.9 **2298**

New Possibilities of Amplification by Carrier Motion in Semiconductors.—E. Groschwitz. (*Z. angew. Phys.*, Aug. & Sept. 1960, Vol. 12, Nos. 8 & 9, pp. 370–382 & 400–410.) Detailed consideration, without mathematical treatment, of the theory underlying the transport processes in semiconductors, on the basis of a hypothetical model. 64 references.

537.311.33: 621.391.822 **2299**

On the Influence of Diffusion and Surface Recombination upon the GR Noise Spectrum of Semiconductors.—K. S. Champlin. (*Physica*, Sept. 1960, Vol. 26, No. 9, pp. 751–760.) Several theories of generation-recombination noise in nearly intrinsic semiconductors [see e.g. 2422 of 1959 (Van Vliet & Van der Ziel)] are critically examined, and it is shown that these theories do not allow for the correlation between Fourier coefficients of different spatial modes of the fluctuations in carrier density. A treatment based on a transmission line analogy is presented and the result examined for the cases when the recombination process is limited by (*a*) volume, (*b*) surface, and (*c*) diffusion.

537.323 **2300**

Investigation of the Thermoelectric Properties of $CoSb_3$ Compound with Sn, Te and Ni Impurities.—B. N. Zaitsina & L. D. Dudkin. (*Fiz. Tverdogo Tela*, Dec. 1959, Vol. 1, No. 12, pp. 1821–1827.)

537.323 **2301**

Anomalous Thermoelectric Properties of Gadolinium Selenide.—R. C. Vickery & H. M. Muir. (*Nature, Lond.*, 22nd April 1961, Vol. 190, No. 4773, pp. 336–337.) Anomalies in parameter interrelations of a high *Z*-value $GdSe$-Gd_2Se_3 composition can be explained in terms of a transport mechanism which is visualized as e.m. waves of thermal frequency ("thermons") acting as charge carriers.

537.563 **2302**

Change in the Work Function of Molybdenum on Deposition of Thin Sodium and Caesium Films.—V. N. Logoshinskaya & V. N. Britsgurov. (*Fiz. Tverdogo Tela*, Dec. 1959, Vol. 1, No. 12, pp. 1806–1812.)

538.221 **2303**

Threshold Concentration for the Existence of Ferromagnetism in Dilute Alloys.—M. Coopersmith & R. Brout. (*J. Phys. Chem. Solids*, Jan. 1961, Vol. 17, Nos. 3/4, pp. 254–258.) See also 817 of 1960 (Brout).

538.221 **2304**

Magnetization of Iron-Nickel Alloys under Hydrostatic Pressure.—J. S. Kouvel & R. H. Wilson. (*J. appl. Phys.*, March 1961, Vol. 32, No. 3, pp. 435–441.)

538.221 **2305**

The Relation between Switching Coefficient and Limiting Frequency of Ferromagnetic Materials.—R. Boll. (*Z. angew. Phys.*, Aug. 1960, Vol. 12, No. 8, pp. 364–370.) Investigation of the dynamic characteristics of ferromagnetic materials, including thin films, allowing for spin-relaxation and eddy-current losses. For related work on metal tapes see 1581 of May. 49 references.

538.221 : 534.231-8 **2306**

Movement of Bloch Walls in Ultrasonic Fields.—G. Haacke & J. Jaumann. (*Z. angew. Phys.*, July 1960, Vol. 12, No. 7, pp. 289–297.) Investigations were made on single-crystal Ni in a 1-Mc/s ultrasonic field. Changes in Bitter patterns are illustrated and the results interpreted.

538.221 : 537.533.7 **2307**

Antiparallel Weiss Domains as Biprisms for Electron Interference Effects.—H. Boersch, H. Hamish, D. Wohlleben & K. Grohmann. (*Z. Phys.*, 16th Aug. 1960, Vol. 159, No. 4, pp. 397–404.) The interference effects used in electron-optics investigations of domain patterns (see 2313 below) are studied experimentally; results obtained are in agreement with theory proposed by Aharonov & Bohm (821 of 1960).

538.221 : 538.213 **2308**

Locus Curves of Complex Permeability of Thin Tapes.—R. Boll. (*Frequenz*, July 1960, Vol. 14, No. 7, pp. 227–238.) Measurements of permeability on tapes of Ni-Fe and Cu-Fe alloy give results which differ considerably from locus curves based on classical eddy-current theory. These differences are attributable to electron-spin relaxation and resonance effects. See 1581 of May.

538.221 : 539.619 **2309**

Limitations of the Magneto-optic Kerr Technique in the Study of Microscopic Magnetic Domain Structures.—D. Treves. (*J. appl. Phys.*, March 1961, Vol. 32, No. 3, pp. 356–366.)

538.221 : 539.23 **2310**

The Interaction of Thin Nickel Films in Ni-Cu Multilayer Systems with Stress-Induced Uniaxial Anisotropy.—M. Rauke. (*Mber. dtsch. Akad. Wiss. Berlin*, 1960, Vol. 2, Nos. 5/6, pp. 303–305.) The coercive force is plotted as a function of Ni-film spacing for Ni-film thicknesses of 275, 575 and 1 350 Å. See also 3208 of 1960.

538.221 : 539.23 **2311**

The Investigation of Slow Magnetization Processes in Thin Films.—W. Hellenthal. (*Naturwissenschaften*, Aug. 1960, Vol. 47, No. 16, p. 371.) A note on the investigation of magnetic reversal in thin films as a function of time and reverse field strength; typical curves are reproduced.

538.221 : 539.23 : 535.614 **2312**

Microscopic Observation of Straight and Curved Magnetization Structure by means of the Faraday Effect.—H. Boersch & M. Landseck. (*Z. Phys.*, 13th July 1960, Vol. 159, No. 3, pp. 248–252.) Magnetic domains in thin vapour-deposited Fe films are rendered visible by the method given in 1162 of 1957 (Fowler & Fryer) in conjunction with a high-resolution microscope technique. See also 4324 of 1960 (Boersch et al.).

538.221 : 539.23 : 621.385.833 **2313**

Electron-Optics Investigations of Weiss Domains in Thin Iron Films.—H. Boersch, H. Raith & R. Wohlleben. (*Z. Phys.*, 16th Aug. 1960, Vol. 159, No. 4, pp. 388–396.) A schlieren method [3964 of 1960 (Boersch & Raith)] and a shadow-projection method [e.g. 2085 of 1960 (Fuller & Hale)] are described and results obtained with these methods are illustrated and discussed.

538.221 : 621.318.134 **2314**

The Ionic Distribution in the Garnets $Gd_3Al_3Fe_2O_{12}$ and $Y_3Al_3Fe_2O_{12}$.—C. E. Miller. (*J. Phys. Chem. Solids*, Jan. 1961, Vol. 17, Nos. 3/4, pp. 229–231.)

538.221 : 621.318.134 **2315**

On the Structure and Oxygen Content of Copper and Copper-Manganese Ferrite.—A. Bergstein & L. Červinka. (*J. Phys. Chem. Solids*, Feb. 1961, Vol. 18, Nos. 2/3, pp. 264–265.)

538.221 : 621.318.134 **2316**

Magnetocrystalline Anisotropy of Cobalt-Substituted Manganese Ferrite.—J. C. Slonczewski. (*J. Phys. Chem. Solids*, Feb. 1961, Vol. 18, Nos. 2/3, pp. 269–271.)

538.221 : 621.318.134 **2317**

Ultra-High-Frequency Properties of Yttrium and Lutecium Ferrite with Garnet-Type Structure.—A. G. Gurevich,

J. G. Gubbe & A. P. Ivanovskii. (*Fiz. Tverdogo Tela*, Dec. 1959, Vol. 1, No. 12, pp. 1862–1863.) Results of measurements of ferromagnetic resonance, permeability and permittivity are reported.

538.221: 621.318.134 **2318**

Growing Single Crystals of Yttrium Ferrite.—A. G. Titova. (*Fiz. Tverdogo Tela*, Dec. 1959, Vol. 1, No. 12, pp. 1871–1873.) Crystals 12 mm high were obtained using B_2O_3 as the solvent. See 1289 of 1959 (Nielsen & Dearborn).

538.221: 621.318.134: 538.569.4 **2319**

Paramagnetic Resonance in Yttrium Ferrite Single Crystals.—A. G. Gurevich & I. E. Gubkin. (*Fiz. Tverdogo Tela*, Dec. 1959, Vol. 1, No. 12, pp. 1847–1858.) A report of measurements at 9·23 cm λ on $Y_3Fe_5O_{12}$ single crystals obtained from solution.

538.221: 621.318.134: 538.569.4 **2320**

Paramagnetic Resonance of Fe^{3+} in Octahedral and Tetrahedral Sites in Yttrium Gallium Garnet ($YGaG$) and Anisotropy of Yttrium Iron Garnet (YIG).—S. Geschwind. (*Phys. Rev.*, 15th Jan. 1961, Vol. 121, No. 2, pp. 363–374.)

538.221: 621.318.134: 538.569.4 **2321**

Relaxation Mechanisms in Ferromagnetic Resonance.—T. Kasuya & R. C. LeCraw. (*Phys. Rev. Lett.*, 1st March 1961, Vol. 6, No. 5, pp. 223–225.) Recent observations of the relaxation time of spin waves with zero wave vector in Y-Fe garnet are given and theory accounting for the results is outlined.

548.0: 538.6 **2322**

Direction Dependence of Physical Properties in Crystals with Particular Regard to Galvanomagnetic and Thermomagnetic Effects.—H. Bross. (*Z. Naturf.*, Oct. 1960, Vol. 15a, No. 10, pp. 859–874.) A method is given for determining the influence of crystal symmetry on the direction dependence of the tensors defining crystal properties. A phenomenological theory of galvanomagnetic and thermomagnetic effects is developed.

MATHEMATICS

517.56: 621.372.44 **2323**

Analytical Representation of the Characteristics of Nonlinear Two-Poles.—W. Böning. (*Arch. Elektrotech.*, 1st July 1960, Vol. 45, No. 4, pp. 265–278.) Nonlinear characteristics are approximated by simple algebraic and transcendental functions. Curves are given for the determination of the requisite coefficients. For related graphical methods see 3459 of 1956 (Fischer & Moser).

519.281.1: 621.391 **2324**

The Significance of Moments in Time and Frequency Functions.—H. Dobesch & H. Sulanke. (*Nachr Tech.*, June 1960, Vol. 10, No. 6, pp. 240–246.) The classical method of moments is outlined and its application to the determination of transmission characteristics of communication channels is discussed.

MEASUREMENTS AND TEST GEAR

621.317.2: 538.566.08] + 534.844.1 **2325**

Reverberation Chamber Technique and Construction of a Large Reverberation Chamber for Electromagnetic Waves.—E. Meyer, H. W. Helberg & S. Vogel. (*Z. angew. Phys.*, Aug. 1960, Vol. 12, No. 8, pp. 337–346.) The use of reverberation-chamber techniques for the measurement of e.m. absorption is discussed with reference to absorption measurements in a small echo chamber. The large chamber described (see 1393 of May) is also intended for acoustic measurements.

621.317.3.029.65: 621.391.822 : 621.387 **2326**

Determination of Noise Temperature of a Gas-Discharge Noise Source for Four-Millimetre Waves.—W. Jasinski & G. Hiller. (*Proc. Inst. Radio Engrs*, April 1961, Vol. 49, No. 4, pp. 807–808.) The hot body standard was a heated Si wedge in a waveguide.

621.317.335: 621.372.413 **2327**

Correction Term for Dielectric Measurements with Cavity Resonators.—E. S. Hotston. (*J. sci. Instrum.*, April 1961, Vol. 38, No. 4, pp. 130–131.) "The effect of varying the diameter of a polystyrene disk on the value of its dielectric constant when measured in a resonator of fixed diameter is investigated. Agreement is obtained with results predicted by perturbation theory."

621.317.335.3: 538.221: 621.318.134 **2328**

Measurement Equipment for the Determination of the Permeability Tensor and Dielectric Constant of Ferrites at 3 000 Mc/s.—W. Nowak. (*Hochfrequenztech. u. Elektroakust.*, June 1960, Vol. 69, No. 3, pp. 83–94.) The principle used is that of measurement inside a circularly polarized cavity resonator; the method of resonator excitation has been simplified.

621.317.341.2.029.4 **2329**

Nyquist Diagram Tracer for A.F.—A. R. Bailey. (*Electronic Technol.*, May 1961, Vol. 38, No. 5, pp. 156–159.) Details are given of a laboratory instrument for determining the Nyquist diagram of a circuit in the frequency range 20 c/s–20 kc/s.

621.317.6: 621.396.663 **2330**

Frequency-Independent Measurement of Complex Ratios by means of the Goniometer.—H. Fricke. (*Elektrotech. Z., Edn A*, 6th June 1960, Vol. 81, No. 12, pp. 422–427.) The principle of operation of the inductive goniometer is outlined and procedures for determining the ratio of electrical quantities in terms of phase and amplitude are described. A diagram is given for evaluating the ratio when the position and magnitude of the goniometer minimum are known. See also 3013 of 1960.

621.317.7: 621.391.822 **2331**

Sampling Technique for Measuring Gaussian Noise.—A. J. Rainal. (*Rev. sci. Instrum.*, March 1961, Vol. 32, No. 3, pp. 327–331.) The noise has a uniform power spectrum from 0·1 c/s to 3 kc/s.

621.317.75: 621.374: 681.142 **2332**

Accurate Amplitude Discrimination Analyser combining Analogue and Digital Logic.—T. A. Brubaker & G. A. Kuhn. (*Rev. sci. Instrum.*, March 1961, Vol. 32, No. 3, pp. 317–322.) A new precision analyser yields digital readout of probability or probability density for random waveforms at low audio frequencies. The use of analogue-computer techniques permits convenient assembly of such instruments. See 1737 of 1960 (Bickart).

OTHER APPLICATIONS OF RADIO AND ELECTRONICS

551.508.71: 537.322.15 **2333**

An Automatic Dew-Point Hygrometer using Peltier Cooling.—P. Gerthsen, J. A. A. Gilsing & M. van Tol. (*Philips tech. Rev.*, 7th June 1960, Vol. 21, No. 7, pp. 196–200.)

551.510.62: 621.372.413 **2334**

Free-Balloon-Borne Meteorological Refractometer.—J. F. Theisen & E. E. Gossard. (*J. Res. nat. Bur. Stand.*, March/April 1961, Vol. 65D, No. 2, pp. 149–154.) A 400-Mc/s refractometer for the investigation of layer-type discontinuities in the troposphere is described.

621.362: 621.387 **2335**

Interpretation of Experimental Characteristics of Cesium Thermionic Converters.—E. N. Carabateas, S. D. Pezaris & G. N. Hatsopoulos. (*J. appl. Phys.*, March 1961, Vol. 32, No. 3, pp. 352–358.) Two types of V/T curves can be distinguished in the operation of a Cs converter: collision-free type and sheath type. A method is outlined for obtaining the electron temperature from the sheath-type curve. The emitter work function and temperature can then be estimated.

621.398: 681.142 **2336**

An Equipment for Automatically Processing Time-Multiplexed Telemetry Data.—N. Purnell & T. T. Walters. (*J. Brit. Instn Radio Engrs*, March 1961, Vol. 21, No. 3, pp. 257–274.) Details are given of the way in which the input signals are derived and the method by which the recordings are made. The equipment produces two forms of output; (*a*) analogue graphs on paper film and (*b*) digital records on punched cards. Methods of checking performance are described.

681.175: 621.374.3 **2337**

A Novel Digital Clock.—A. Russell. (*Electronic Engng*, March 1961, Vol. 33, No. 397, pp. 150–154.) An indicator of the minute, hour and date together with a four-figure test number, which employs telephone-type uniselectors, is operated by a separate seconds generator. The output is suitable for operating a tape perforator or an electronic typewriter.

PROPAGATION OF WAVES

621.391.812.6.029.45 **2338**

A Note on Phase Velocity of V.L.F. Radio Waves.—J. R. Wait & K. P. Spies. (*J. geophys. Res.*, March 1961, Vol. 66, No. 3, pp. 992–993.) The phase velocity is plotted as a function of frequency in the range 8–30 kc/s for ionospheric heights of 60–100 km using formulae given earlier (4367 of 1960).

621.391.812.6.029.6: 537.56 **2339**

Microwave Propagation through a Magnetoplasma.—R. L. Phillips, R. G. DeLosh & D. E. White. (*J. appl. Phys.*, March 1961, Vol. 32, No. 3, pp. 551–552.) Plasma sheaths surrounding space vehicles can severely attenuate radio signals. By using a sufficiently strong magnetic field aligned along the direction of propagation, this attenuation can be reduced. The preliminary results of laboratory experiments are given.

621.391.812.61 **2340**

Weather and Reception Level on a Troposphere Link—Annual and Short-Term Correlations.—L. G. Abraham, Jr, & J. A. Bradshaw. (*J. Res. nat. Bur. Stand.*, March/April 1961, Vol. 65D, No. 2, pp. 155–156.) The weather parameters suggested by the Booker-Gordon theory (1757 of 1950) are correlated with data from a troposphere link not previously reported. While the correlations over the whole year's weather cycle are high, the short-term correlations practically vanish. The former without the latter lend little support to this theory.

621.391.812.62 **2341**

Properties of Tropospheric Scattered Fields.—N. R. Ortwein, R. U. F. Hopkins & J. E. Pohl. (*Proc. Inst. Radio Engrs*, April 1961, Vol. 49, No. 4, pp. 788–802.) Scatter tests were made in S. California in conjunction with meteorological measurements. The observed angular scattering of the received field varies as $\theta^{-14/3}$ which is consistent with turbulent spectra varying as $k^{-5/3}$. Reflections from layers become important in the lower frequency range when the atmosphere begins to stabilize.

621.391.812.621 **2342**

Graphical Determination of Radio Ray Bending in an Exponential Atmosphere.—C. F. Pappas, L. E. Vogler & P. L. Rice. (*J. Res. nat. Bur. Stand.*, March/April 1961, Vol. 65D, No. 2, pp. 175–179.) A simplified method is given for calculating the approximate refraction angle as a function of height, for values of surface refractivity ranging from 200 to 450.

621.391.812.621 **2343**

A Formula for Radio Ray Refraction in an Exponential Atmosphere.—G. D. Thayer. (*J. Res. nat. Bur. Stand.*, March/April 1961, Vol. 65D, No. 2, pp. 181–182.) The formula is derived by integration of a differential equation, assuming that $(n-1) \times 10^6$ decreases exponentially with height above a smooth spherical earth.

621.391.812.622 **2344**

The Effect of Multiple Atmospheric Inversions on Tropospheric Radio Propagation.—F. H. Northover. (*J. atmos. terr. Phys.*, April 1961, Vol. 20, No. 4, pp. 295–296.) A method of analysis developed for a single inversion is extended to account for the collective effect of several simultaneously occurring inversions.

621.391.812.63 **2345**

A Theory of Incoherent Scattering of Radio Waves by a Plasma.—J. P. Dougherty & D. T. Farley. (*Proc. roy. Soc.*, 22nd Nov. 1960, Vol. 259, No. 1296, pp. 79–99.) The amplitude and frequency spectrum of the scattered radiation are calculated making use of a generalized version of Nyquist's noise theorem, and the results are applied to incoherent scatter from the ionosphere. The amplitude is consistent with independent scattering by electrons; the mean Doppler broadening corresponds roughly to the speed of the ions rather than the electrons. The spectral shape is not Gaussian; there is a slight dip at the centre frequency. Plasma resonance effects are negligible for frequencies in use at present.

621.391.812.63 **2346**

The Reflection of Radio Waves from an Iceshelf.—W. R. Piggott & L. W. Barclay. (*J. atmos. terr. Phys.*, April 1961, Vol. 20, No. 4, pp. 298–299.) Information concerning the r.f. properties of the iceshelf is deduced from certain properties of the vertical-incidence ionospheric records made at Halley Bay, Antarctica.

621.391.812.63 **2347**

Correlation Analysis of the Fading of Radio Waves Reflected Vertically from the Ionosphere.—G. F. Fooks & I. L. Jones. (*J. atmos. terr. Phys.*, April 1961, Vol. 20, No. 4, pp. 229–242.) The fading of h.f. waves, after reflection from the E and F layers, has been analysed. Magnetic conditions were quiet. The results, obtained from spaced receivers, give the size and shape of an average irregularity in the ground pattern, the drift velocity and the relative importance of random changes to drift in producing fading.

621.391.812.63 **2348**

Effect of Antenna Radiation Angles upon H.F. Radio Signals Propagated over Long Distances.—W. F. Utlaut. (*J. Res. nat. Bur. Stand.*, March/April 1961, Vol. 65D, No. 2, pp. 167–174.) Observations on a 20-Mc/s c.w. signal over E–W paths of 6800 km and 8400 km indicate that aerials with very low radiation angle may be advantageous for long-distance reception.

621.391.812.63.029.62 **2349**

Relationship between f_0E_s and Field Intensity depending on Sporadic-E Propagation in the 50-Mc/s Band.—M. Yamaoka. (*J. Radio Res. Labs, Japan*, Nov. 1960, Vol. 7, No. 34, pp. 599–613.) Transmissions from Okinawa on 49·68 Mc/s were received at five points in Japan at distances from 1100 to 2390 km. The field intensity is shown graphically as a function of distance and E_s-layer critical frequency.

621.391.812.631 **2350**

Polar-Cap Blackout and Auroral-Zone Blackout.—Y. Hakura. (*J. Radio Res. Labs, Japan*, Nov. 1960, Vol. 7, No. 34, pp. 583–597.) A statistical analysis of ten polar-cap events during the I.G.Y. is used to examine the characteristics of the two types of blackout. A detailed examination of the event of 29th July 1958 demonstrates that the two types represent distinct phases; the solar corpuscles responsible are considered.

621.391.812.631: 551.510.535(98) **2351**

High-Frequency Radio-Wave Blackouts at Medium and High Latitudes during a Solar Cycle.—C. Collins, D. H. Jelly & A. G. Matthews. (*Canad. J. Phys.*, Jan. 1961, Vol. 39, No. 1, pp. 35–52.) An examination of ionograms for the occurrence over Canada of blackouts correlating with riometer measurements of type II (auroral) and type III (polar-cap) absorption events has revealed distinct geographical patterns of blackout occurrence. Study of ionosonde data back to 1949 shows different sunspot cycle variations for the two events.

621.391.814: 537.56] + 621.372.826 **2352**

Propagation of Electromagnetic Waves along a Thin Plasma Sheet.—J. R. Wait. (*Canad. J. Phys.*, 1960, Vol. 38, No. 12, pp. 1586–1594.) "It is shown that a thin ionized sheet will support a trapped surface wave. The effect of a constant and uniform magnetic field is to modify the phase velocity and polarization of the surface wave. The essential features are illustrated by numerical results for selected values of the electron density, collision frequency and gyro frequency. The effect of locating the plasma sheet near and parallel to a conducting plane is also considered. In this situation other modes of a waveguide type are possible in addition to the surface wave."

621.391.814.029.64 + 621.372.826 **2353**

TE Surface Waves Guided by a Dielectric-Covered Metal Plane.—D. Morris & A. G. Mungall. (*Canad. J. Phys.*, Dec. 1960, Vol. 38, No. 12, pp. 1553–1559.) Surface waves were excited over a sand-covered metal plane and the phase velocities of the first three TE modes were determined, as a function of the sand depth, at a frequency of 9300 Mc/s. The simultaneous existence of two modes with different velocities, predicted theoretically for certain sand depths, was confirmed experimentally. For a report of similar measurements on TM-mode surface waves, see 2892 of 1960 (Mungall & Morris).

RÉCEPTION

621.376.23: 621.391.82 **2354**

Questions of Potential Noise Immunity when the Signal Fades.—D. D. Klovskiĭ. (*Radiotekhnika, Mosk.*, May 1960, Vol. 15, No. 5, pp. 17–25.) Criteria are obtained for coherent and noncoherent detection processes in an ideal receiver in the presence of fluctuating interference and rapid smooth fading. Error probabilities are calculated for different systems.

621.376.23: 621.391.822 **2355**

Further Results on the Detectability of Known Signals in Gaussian Noise.—H. C. Martel & M. V. Mathews. (*Bell Syst. tech. J.*, March 1961, Vol. 40, No. 2, pp. 423–451.) Solutions are given for a maximum-likelihood detector operating on a finite number of samples of the stimulus, and for an optimum integral operator treating the stimulus as a continuous function.

621.376.23: 621.396 962.3 **2356**

Summary and Comparison of Known Methods for the Detection of Periodic Pulses in the Presence of Noise.—D. Haussig. (*Hochfrequenztech. u. Elektroakust.*, June 1960, Vol. 69, No. 3, pp. 94–103.) The improvement of signal/noise ratio, e.g. for radar, by integration or cross-correlation methods is discussed. Practical pulse correlator and integrator circuits are proposed; experimental results are illustrated.

621.391.812.3: 551.510.535 **2357**

Analysis of Random Fading Records.—S. R. Khastgir & R. N. Singh. (*Indian J. Phys.*, Nov. 1960, Vol. 34, No. 11, pp. 527–530.) An analysis of experimental results obtained using three spaced receivers on a frequency of 3·8 Mc/s. See also 3859 of 1960.

621.391.823: 621.396.669 **2358**

Interference Suppression of PTT Motor Vehicles.—E. Meister. (*Tech. Mitt. PTT*, 1st Aug. 1960, Vol. 38, No. 8, pp. 271–277. In German and French.) Analysis of the results of tests on motor vehicles of the Swiss Post Office fitted with interference-suppression devices, to assess the effectiveness of the methods of suppression adopted and any influence they may have on the running efficiency of the vehicle. See also 1627 of May (Walter).

621.391.823: 621.396.669 **2359**

Interference Suppression of Vehicles with Petrol Engines.—(*Tech. Mitt. PTT*, 1st Sept. 1960, Vol. 38, No. 9, pp. 314–315. In German, French and Italian.) Description of a suppression method and installation instructions. See also 2358 above.

621.396.62 **2360**

The Effectiveness of Methods of Increasing the Dynamic Range of a Panoramic Radio Receiver.—N. I. Svetlov. (*Radiotekhn. Mosk.*, May 1960, Vol. 15, No. 5, pp. 29–32.) Experiments show that an automatically re-aligned filter comprising two reactance valves in a band-pass circuit not only decreases crosstalk but reduces nonlinear distortion.

621.396.62: 523.164.32 **2361**

Voltage-Tuned Swept-Frequency Receiver.—J. J. Riihimaa. (*Rev. sci. Instrum.*, March 1961, Vol. 32, No. 3, pp. 289–291.) A voltage-tuned solar spectrum analyser, employing Si tuning capacitors, has been developed. It covers the range 15–30 Mc/s at sweep rates up to 10/sec.

621.396.62.029.62 **2362**

Fundamental Requirements for a Good F.M. V.H.F. Broadcast Receiver.—E. Wey. (*Tech. Mitt. PTT*, 1st Aug. 1960, Vol. 38, No. 8, pp. 257–271. In German and French.) Summary touching on sensitivity, selectivity and quality requirements and dealing with the measurement and reduction of interference.

621.396.62.029.62 **2363**

A New Swiss Radio Receiver with V.H.F. Stage, conforming to PTT [Swiss Post Office] **Specifications.**—W. Strohschneider. (*Tech. Mitt. PTT*, 1st Sept. 1960, Vol. 38, No. 9, pp. 304–311. In German and French.) Circuit diagram and design details are given. See also 2362 above.

621.396.62.029.64: 523.164 **2364**

A Low-Noise X-Band Radiometer using Maser.—J. J. Cook, L. G. Cross, M. E. Bair & R. W. Terhune. (*Proc. Inst. Radio Engrs*, April 1961, Vol. 49, No. 4, pp. 768–778.) A reflection cavity maser with voltage-gain × bandwidth products up to 300 Mc/s at 4·2°K is used. The gain instability is < 1% up to 10 min and 2% up to 30 min. A noise factor of 0·6 dB (43°K) has been obtained with r.m.s. noise fluctuations of 0·01°K and 0·007°K for integration times of 12 and 42 sec respectively.

STATIONS AND COMMUNICATION SYSTEMS

621.376.5 **2365**

Pulse Transmission by A.M., F.M. and P.M. in the Presence of Phase Distortion.—E. D. Sunde. (*Bell Syst. tech. J.*, March 1961, Vol. 40, No. 2, pp. 353–422.) Performance in pulse transmission systems using various carrier modulation and detection methods is formulated in terms of a common basic function known as the carrier pulse transmission characteristic. A comprehensive theoretical evaluation of transmission impairment caused by various types of phase and envelope delay distortion is made.

621.391.64: 621.376.223 **2366**

Solid-State Modulators for Infrared Communications.—P. W. Kruse & L. D. McGlauchlin. (*Electronics*, 10th March 1961, Vol. 34, No. 10, pp. 177–181.) Free carrier absorption in a semiconductor may be used to modulate a beam of infrared radiation. Ge modulator characteristics and circuit details of a transmitter/receiver with a range > 1 mile are given.

621.396.215 **2367**

A Comparison between Alternative H.F. Telegraph Systems.—W. Lyons: J. V. Beard & A. J. Wheeldon. (*Point to Point Telecommun.*, Feb. 1961, Vol. 5, No. 2, pp. 11–17.) Comment on 1026 of March and authors' reply.

621.396.4: 621.376.23 **2368**

Suppressed-Carrier Double-Sideband Systems.—G. W. Short. (*Wireless World*, May 1961, Vol. 67, No. 5, pp. 242–243.) Summarizes receiving techniques and system advantages and difficulties.

621.396.43: [523.3 + 551.507.362.2 **2369**

Use of Moon or Satellite Relays for Global Communications.—L. P. Yeh. (*Commun. & Electronics*, Nov. 1960, No. 51, pp. 607–615.) Results of the major moon-echo experiments are summarized and compared in tabular form. General conclusions regarding the use of the moon as a passive and an active relay are discussed in relation to the performances expected of similar satellite relays.

621.396.43: 621.391.812.826 **2370**

Analysis and Detection of Echo Signals on Microwave Radio Paths.—G. E. Rosman. (*Proc. Instn Radio Engrs, Aust.*, Nov. 1960, Vol. 21, No. 11, pp. 810–820.) The permissible echo parameters for a 600-channel circuit and the effects of aerial directivity for a 40-mile path at 4 Gc/s are assessed.

621.396.65 **2371**

The Radio Telephone Terminal.—B. W. Bardwell. (*Point to Point Telecommun.*, Feb. 1961, Vol. 5, No. 2, pp. 28–54.) Deals with the functions of the terminal, especially with reference to independent-sideband working.

621.396.65: 621.391.812.624 **2372**

A Tropospheric Scatter Link over a 200-Mile Path.—G. L. Grisdale & D. A. Paynter. (*Point to Point Telecommun.*, Oct. 1960, Vol. 5, No. 1, pp. 34–59.) Operating experience with the 1958–1959 Start Point–Galleywood link showed that, using diversity reception, communication with a 24-telephone channel system on 858 Mc/s was reliable for 99% of the time.

621.396.65: 621.398 **2373**

Telemetering and Remote Control over Radio Links.—S. Skoumal. (*Point to Point Telecommun.*, Oct. 1960, Vol. 5, No. 1, pp. 15–33.) A discussion of different methods and systems.

621.396.932 **2374**

Use and Service Time of Short Waves: Predictions for the Spanish Sea Routes.—R. Gea Sacasa. (*Rev. Telecomunicación, Madrid*, Sept. 1960, Vol. 16, No. 61, pp. 2–16.) See also 1779 of 1960.

621.396.934: 551.507.362.2 **2375**

New Satellite Tracking Station in Great Britain.—(*J. Brit. Instn Radio Engrs*, Feb. 1961, Vol. 21, No. 2, pp. 130–132.) A general description of the 136-Mc/s Minitrack radio interferometer. For a similar account see *Electronic Engng*, March 1961, Vol. 33, No. 397, pp. 160–161.

621.396.945 **2376**

Radio-Wave Propagation in the Earth's Crust.—H. A. Wheeler. (*J. Res. nat. Bur. Stand.*, March/April 1961, Vol. 65D, No. 2, pp. 189–191.) A note on the presence of a 'waveguide' in the earth's crust, composed of low-conductivity basement rock, and its application to v.l.f. communication problems.

621.396.946: 621.391.63 **2377**

Interstellar and Interplanetary Communication by Optical Maser.—R. N. Schwartz & C. H. Townes. (*Nature, Lond.*, 15th April 1961, Vol. 190, No. 4772, pp. 205–208.) An examination of the possibility of transmitting an optical beam from a planet associated with a star at a sufficiently high power level to establish communications with the earth.

SUBSIDIARY APPARATUS

621.3.017.7: 621.373.421.13 **2378**

The Change-of-State Crystal Oven.—D. J. Fewings. (*J. Brit. Instn Radio Engrs*, Feb. 1961, Vol. 21, No. 2, pp. 137–142.) The action of the oven depends upon the constancy of the melting point of crystalline material and the thermal ballasting due to the latent heat of fusion. An oven of this type can restrict the frequency shift to 2·8 parts in 10^8 for a temperature change of 10°C.

621.311.68: 621.316.726 **2379**

Precise Frequency Control for a Rotary Convertor.—M. J. Tucker. (*Electronic Engng*, April 1961, Vol. 33, No. 398, pp. 240–241.) "The Royal Research Ship 'Discovery II' has been provided with a 50 c/s power supply whose frequency is precise to approximately 1 part in 10^8, by locking the phase of a small rotary convertor to that of a 50 c/s reference signal derived from a quartz-crystal oscillator."

621.311.69: 621.383.5 **2380**

Detailed Balance Limit of Efficiency of *p-n* Junction Solar Cells.—W. Shockley & H. J. Queisser. (*J. appl. Phys.*, March 1961, Vol. 32, No. 3, pp. 510–519.) A theoretical upper limit for efficiency is deduced assuming that recombination is entirely radiative. Maximum efficiencies of 30% are found.

621.311.69: 621.383.5 **2381**

Characteristics of a High Solar Conversion Efficiency Gallium Arsenide *p-n* Junction.—E. G. Bylander, A. J. Hodges & J. A. Roberts. (*J. opt. Soc. Amer.*, Oct. 1960, Vol. 50, No. 10, pp. 983–985.) Spectral emissivity and response data are given for GaAs photocells which have an open-circuit voltage of about 0·85 V and short-circuit current density 13–15 mA/cm^2.

621.314.1: 621.382.3 **2382**

The Choice and Design of D.C. Convertors.—J. S. Bell & P. G. Wright. (*Electronic Engng*, April 1961, Vol. 33, No. 398, pp. 226–231.) The design of single- and two-transformer converters using transistors is discussed and their performances are compared. Design steps are indicated and two practical examples are given.

621.314.63 **2383**

Power Semiconductor Ratings under Transient and Intermittent Load.—F. W. Gutzwiller & T. P. Sylvan. (*Commun. & Electronics*, Jan. 1961, No. 52, pp. 699–706. Discussion.) Methods of calculating maximum allowable dissipation are discussed, with examples.

621.314.63 **2384**

Transient Thermal Impedance of Semiconductor Devices.—E. J. Diebold & W. Luft. (*Commun. & Electronics*, Jan. 1961, No. 52, pp. 719–726.)

621.316.72: 621-52 **2385**

A New D.C. Level Control for Adaptive Systems.—R. A. Johnson & J. D. Hill. (*Electronic Engng*, April 1961, Vol. 33, No. 398, pp. 242–244.) A novel electronic circuit is described and analysed which maintains the potential drop across a load constant to within a fraction of 1% while permitting the d.c. level of the load to be varied through a wide range. The circuit requires only standard-tolerance electronic components and high precision is obtained by an error compensation technique.

TELEVISION AND PHOTOTELEGRAPHY

621.397.13 **2386**

Television Standards.—H. Dobesch. (*Radio u. Fernsehen*, July 1960, Vol. 9, No. 14, pp. 447–449.) Comparative data tables and waveform diagrams are given for the seven monochrome television systems in present use.

621.397.132 **2387**

Distortion due to System and Transmission Faults in Colour Television based on the N.T.S.C. System.—H. Schönfelder. (*Rundfunktech. Mitt.*, Aug. 1960, Vol. 4, No. 4, pp. 158–172.) Faults likely to occur in the N.T.S.C. system are reviewed; their effect on picture quality is shown to be small in most cases.

621.397.132 **2388**

Critical Consideration of the 'Henri de France' Colour Television System and a Modification with Better Vertical Resolution.—P. Neidhardt. (*Nachr Tech.*, July 1960, Vol. 10, No. 7, pp. 286–290.) A comparison of the 'Henri de France' system (e.g. 3660 of 1960) and the N.T.S.C. system, with suggestions for improving the former.

621.397.334 **2389**

Modern Aspects of the Design of Colour-Television Film Scanners with Flying-Spot Tubes.—P. Neidhardt. (*Elektronische Rundschau*, Aug. 1960, Vol. 14, No. 8, pp. 307–313.) Review of the optical and mechanical problems involved in the design of flying-spot scanners with details of some of the solutions adopted in various systems.

621.397.334 **2390**

Optical Problems with Flying-Spot Colour Scanners.—G. Emmrich. (*Nachr-Tech.*, July 1960, Vol. 10, No. 7, pp. 290–295.) Difficulties of optical system design are discussed with reference to existing types of scanner.

621.397.334 **2391**

Experiences with a Colour-Television Transparency Scanner.—M. Samlenski. (*Nachr Tech.*, July 1960, Vol. 10, No. 7, pp. 295–298, plate.) Design problems of a flying-spot scanner for colour transparencies are discussed.

621.397.334 **2392**

Prospects for Colour Picture Tubes with only One Electron-Beam System in Comparison with the Triple-Beam Mask-Type Tubes.—I. Bornemann. (*Nachr Tech.*, July 1960, Vol. 10, No. 7, pp. 305–309.)

621.397.612 **2393**

New Problems in the Design of Video Switching Installations.—L. W. Germany. (*Rundfunktech. Mitt.*, Aug. 1960, Vol. 4, No. 4, pp. 145–152.) The factors governing the choice of a television studio master control system are reviewed and various methods of switching and program control are described, including a system in which timing is controlled automatically by punched paper tape.

621.397.62: 621.382.3 **2394**

The Transistorized TV Receiver using a New Horizontal Deflection System.—T. Miura & K. Mano. (*Sci. Rep. Res. Inst. Tohoku Univ., Ser. B*, 1960, Vol. 12, No. 1, pp. 41–55.) The horizontal deflection system described uses six power transistors in a series/parallel combination in the output stage. Sufficient output is provided to operate a 17-in. 90° tube.

621.397.62: 621.396.67 **2395**

The Influence of Mismatch on Television Picture Quality in Single- and Common-Aerial Installations.—A. Köhler. (*Funktechnik, Berlin*, Sept. 1960, Vol. 15, No. 17, pp. 604–607.) Attenuation and reflection effects are considered and practical aspects of installation design minimizing mismatch are discussed.

621.397.621: 621.385.832 **2396**

A Low-Power Cathode for Television Picture Tubes.—H. E. Smithgall. (*Sylvania Technologist*, Oct. 1960, Vol. 13, No. 4, pp. 118–121.) A heater-cathode assembly with a diameter of 0·05 in., thickness 0·011 in. and rated power of 0·21 W is described. It is rugged mechanically, operates over a range of 1·2–1·6 V, and has a heating time of 10 sec for stable operation.

621.397.7-182.3 **2397**

Television Outside-Broadcasting by the Radiodiffusion-Television Française.—(*E.B.U. Rev.*, Aug. 1960, No. 62A, pp. 150–154.) Light-weight equipment is described and methods of outside-broadcast operation are mentioned.

621.397.74 **2398**

Requirements for and Measurements on Long-Distance Television Links.—J. Müller. (*Nachrichtentech. Z.*, July 1960, Vol. 13, No. 7, pp. 327–334.) C.C.I.R. recommendations are outlined and results are given of measurements based on these, which were made on a 4-Gc/s radio link over 2 000 km. Tests to assess the suitability of the system for N.T.S.C. colour television are proposed.

621.397.74 (485) **2399**

The Development of the Television Network in Sweden.—T. Rosenlund. (*E.B.U. Rev.*, Aug. 1960, No. 62A, pp. 162–163.)

VALVES AND THERMIONICS

621.382.2/.3 : 061.3 **2400**

International Symposium on Semiconductor Devices.—A. V. J. Martin. (*Électronique et Automatisme*, March/April 1961, No. 9, pp. 145–150, 168.) Report of a Unesco symposium held in Paris, 20th–25th February 1961. The titles of all papers presented are given and selected papers are reviewed.

621.382.23 **2401**

Effect of Fluctuations in Density on the Esaki Effect.—D. G. Dow. (*Proc. Inst. Radio Engrs*, April 1961, Vol. 49, No. 4, p. 837.) Some theoretical expressions are developed and numerically evaluated to assess the extent of spatial fluctuations of tunnel current to be expected in an Esaki diode.

621.382.23 **2402**

Tunnel-Diode Large-Signal Simulation Study.—S. B. Geller & P. A. Mantek. (*Proc. Inst. Radio Engrs*, April 1961, Vol. 49, No. 4, pp. 803–804.) An equivalent circuit is investigated for dynamic response using both analogue simulation and graphical analysis.

621.382.23 **2403**

Oscillations in the Longitudinal Tunnel Current of Tunnel Diodes.—R. R. Haering & P. B. Miller. (*Phys. Rev. Lett.*, 15th March 1961, Vol. 6, No. 6, pp. 269–271.) Small fluctuations in the electron term level are proposed to explain observed oscillations in tunnel current in a longitudinal magnetic field [1239 of April (Chynoweth et al.)].

621.382.23 **2404**

Influence of the State of the Surface on the Breakdown Voltage of Alloy-Type Silicon Diodes.—Zh. I. Alferov & E. V. Silina. (*Fiz. Tverdogo Tela*, Dec. 1959, Vol. 1, No. 12, pp. 1878–1879.) A note on the change in breakdown voltage when the surface states are cyclically reproduced. Typical I/V characteristics are shown for air, vacuum and after heating in vacuum.

621.382.23 **2405**

'Breakdown' of Alloy-Type Silicon Diodes in the Forward Direction.—Z. I. Alferov & É. A. Yarv. (*Fiz. Tverdogo Tela*, Dec. 1959, Vol. 1, No. 12, pp. 1879–1882.) The absence of any effect of illumination or magnetic field on the breakdown voltage, and other experimental data indicate that breakdown is due to leakage effects of a nonohmic character.

621.382.23 : 621.317.33 **2406**

Measurement of Tunnel-Diode Negative Resistance.—C. D. Todd. (*Rev. sci. Instrum.*, March 1961, Vol. 32, No. 3, pp. 338–342.) Several methods are presented, including an accurate null technique. Test equipment which will allow stabilization of most tunnel diodes is described.

621.382.23 : 621.372.44 **2407**

Three-Layer Negative-Resistance and Inductive Semiconductor Diodes.—W. W. Gärtner & M. Schuller. (*Proc. Inst. Radio Engrs*, April 1961, Vol. 49, No. 4, pp. 754–767.) Combinations of effects in three-layer semiconductor diodes may lead to many negative-resistance and inductive devices with applications to microwave circuit design. The theory underlying these devices and the problems involved are discussed.

621.382.23 : 621.372.44 **2408**

Capacitance Coefficients for Varactor Diodes.—R. D. Weglein & S. Sensiper. (*Proc. Inst. Radio Engrs*, April 1961, Vol. 49, No. 4, p. 810.)

621.382.23 : 621.372.44 **2409**

Comparative Figures of Merit for Available Varactor Diodes.—K. Siegel. (*Proc. Inst. Radio Engrs*, April 1961, Vol. 49, No. 4, pp. 809–810.)

621.382.23 : 621.372.44 **2410**

Parametric Diodes : Design and Fabrication.—D. B. Day. (*J. Brit. Instn Radio Engrs*, March 1961, Vol. 21, No. 3, pp. 283–286.) Short notes on theory, design and fabrication of diodes with cut-off frequencies in the region of 50 Gc/s.

621.382.23 : 621.373.029.631.64 **2411**

Tunnel-Diode Microwave Oscillators.—F. Sterzer & D. E. Nelson. (*Proc. Inst. Radio Engrs*, April 1961, Vol. 49, No. 4, pp. 744–753.) Diodes working between 610 and 8 350 Mc/s are described, with power outputs ranging from 0·01 mW at 7 130 Mc/s to 10 mW at 610 Mc/s. Problems relating to frequency, power output and waveform are treated analytically.

621.382.23 : 621.375.9 **2412**

A Broad-Band Tunnel-Diode Amplifier.—Moody & Wacker. (See 2141.)

621.382.23 : 621.375.9 **2413**

A Noise Investigation of Tunnel-Diode Microwave Amplifiers.—A. Yariv & J. S. Cook. (*Proc. Inst. Radio Engrs*, April 1961, Vol. 49, No. 4, pp. 739–743.) The agreement between the measured noise figure and the theoretical results is an indirect check on the existence of full shot noise in Ge tunnel diodes at microwave frequencies. The approach to the limiting noise temperature in an amplifier by the use of appropriate circuits is discussed.

621.382.23 : 621.376.23 **2414**

The Tunnel Diode as a Highly Sensitive Microwave Detector.—M. D. Montgomery. (*Proc. Inst. Radio Engrs*, April 1961, Vol. 49, No. 4, pp. 826–827.) Good sensitivity has been obtained by biasing the diode near oscillation and operating it as a square-law detector. Experimental results are quoted at frequencies near 1 Gc/s.

621.382.3 **2415**

Transistor Internal Parameters for Small-Signal Representation.—R. L. Pritchard, J. B. Angell, R. B. Adler, J. M. Early & W. M. Webster. (*Proc. Inst. Radio Engrs*, April 1961, Vol. 49, No. 4, pp. 725–738.) A summary report of a Working Group which studied (*a*) the parameters which emphasize the physical mechanism of transistors, (*b*) symbols for these parameters, and (*c*) the relation between these parameters and those employed in circuit analysis and design. 35 references.

621.382.3.012.8 **2416**

A Complete Transistor Equivalent Circuit.—R. H. Beeson. (*Proc. Inst. Radio Engrs*, April 1961, Vol. 49, No. 4, pp. 825–826.) The circuit given is implicit in the analysis of Ebers & Moll (884 of 1955).

621.382.333 **2417**

Measurement of the Number of Impurities in the Base Layer of a Transistor.—H. K. Gummel. (*Proc. Inst. Radio Engrs*, April 1961, Vol. 49, No. 4, p. 834.) The collector current is measured as a function of emitter-to-base voltage. N_B is then calculated from the simple expression given.

621.382.333 **2418**

Silicon Surface Alloy Transistors for High-Frequency Switching and Chopper-Amplifier Applications.—P. A. Charman. (*J. Brit. Instn Radio Engrs*, Feb. 1961, Vol. 21, No. 2, pp. 201–204.)

621.382.333.33 **2419**

The Dependence of Current Gain of Drift Transistors on Emitter Current.—G. Schwabe. (*Z. angew. Phys.*, July 1960, Vol. 12, No. 7, pp. 314–320.) The differences in the gain characteristics of drift and diffusion-type transistors are discussed; at high emitter currents their characteristics become similar.

621.383.5 **2420**

GaAs, a Sensitive Photodiode for the Visible.—G. Lucovsky & P. H. Cholet. (*J. opt. Soc. Amer.*, Oct. 1960, Vol. 50, No. 10, pp. 979–983.) Highly sensitive photodiodes have been formed by diffusion of Cd and Zn in *n*-type GaAs. Operated as photovoltaic detectors the diodes have half-sensitivity points at 9 100 and 5 600 Å and a dynamic impedance of the order of 1 MΩ with time constant 1 ms. Certain diodes are equally sensitive when operated in the photoconductive mode.

621.385.032.213.23 **2421**

On the Electron Emission from Oxide-Coated Cathode subject to Strong Electric Field.—C. Shibata. (*J. phys. Soc. Japan*, Jan. 1961, Vol. 16, No. 1, pp. 51–61.) Deviation of emission from the Schottky

value is explained by an avalanche effect in the oxide layer. Calculated and measured values are compared.

621.385.032.213.23 **2422**

Oxide-Cathode Emission under Positive-Ion Bombardment.—I. A. Abroyan. (*Fiz. Tverdogo Tela*, Dec. 1959, Vol. 1, No. 12, pp. 1854–1856.) Commercial oxide cathodes 5 mm in diameter were bombarded with potassium ions of energy 1–10 keV and hydrogen ions of 5–70 keV. The increase in emission current from the cathode under potassium-ion bombardment reached values of 1 000 to 5 000 electrons per incident ion.

621.385.032.213.23 **2423**

Application of Shot-Noise Techniques to the Study of Emission in Oxide Cathodes.—E. Wolk. (*Sylvania Technologist*, Oct. 1960, Vol. 13, No. 4, pp. 129–136.)

621.385.6 **2424**

Small-Signal Space-Charge Density in Drifting Ion-Neutralized Rectilinear-Flow Beams Immersed in an Axial Magnetic Field of Finite Magnitude.—V. Rovo. (*Proc. Inst. Radio Engrs*, April 1961, Vol. 49, No. 4, pp. 815–816.)

621.385.6 : 621.375.9 : 621.372.44 **2425**

Behaviour of Thermal Noise and Beam Noise in a Quadrupole Amplifier.—R. Adler & G. Wade. (*Proc. Inst. Radio Engrs*, April 1961, Vol. 49, No. 4, p. 802.)

621.385.63 **2426**

S.S. Focusing of an Electron Stream.—C. K. Birdsall & G. W. Rayfield; E. Sugata, M. Terada & K. Ura. (*Proc. Inst. Radio Engrs*, April 1961, Vol. 49, No. 4, pp. 819–821.) Attention is drawn to an error in 3330 of 1960 and further comments by Sugata et al. are included.

621.385.632 **2427**

Matching between Travelling-Wave-Tube Helix and Waveguide.—T. Unotoro. (*Rev. elect. Commun. Lab., Japan*, Nov./Dec. 1960, Vol. 8, Nos. 11/12, pp. 560–572.) The optimum dimensions of the coupling circuit for mass-produced tubes are determined by a statistically designed series of measurements.

621.385.632.1 **2428**

Experiments on a Series of S-Band Cavistrons.—J. E. Rowe, G. T. Konrad & H. W. Krage. (*Commun. & Electronics*, Jan. 1961, No. 52, pp. 828–835.) The operation of this device is discussed and experimental data are given for fixed length and variable-length tubes. The tube is small and operates at high efficiency. See 2427 of 1959 (Rowe).

621.385.832 : 621.397.62 **2429**

Some Electron Trajectories in a Nonuniform Magnetic Field.—T. N. Chin. (*Proc. Inst. Radio Engrs*, April 1961, Vol. 49, No. 4, pp. 832–833.) The nonuniformity is introduced in thin *c.r.* tubes to improve deflection sensitivity and to reduce the width of the scan-producing electromagnet. The equations of the resulting trajectories are derived.

621.385.832 : 621.397.621 **2430**

A Low-Power Cathode for Television Picture Tubes.—Smithgall. (See 2396.)

621.397 : 621.362 **2431**

Interpretation of Experimental Characteristics of Cesium Thermionic Converters.—Carabateas, Powers & Hatsopoulos. (See 2335.)

MISCELLANEOUS

001.6 : 621.37/.39 **2432**

Report of the United States of America National Committee to the XIth General Assembly of the International Scientific Radio Union, London, England, September 5 to 15, 1960.—(*J. Res. nat. Bur. Stand.*, Nov./Dec. 1960, Vol. 64D, No. 6, pp. i–v & 591–767.) A brief report is given by each Commission of the progress made in its field during the period 1957–1960.

538.569.2.047 **2433**

Some Technical Aspects of Microwave Radiation Hazards.—W. W. Mumford. (*Proc. Inst. Radio Engrs*, Feb. 1961, Vol. 49, No. 2, pp. 427–447.) A review of information available and of the safety measures adopted by Bell Laboratories. A recommended method of calculating power densities is derived and some commercial power-density meters are described. 76 references.

621.3 (083.7) **2434**

Supplement to I.R.E. Standards on Graphical Symbols for Electrical Diagrams, 1954.—(*Proc. Inst. Radio Engrs*, Feb. 1961, Vol. 49, No. 2, pp. 467–468.) Standard 54 I.R.E. 21. S1.

621.37/.38].029.6 **2435**

Recent Developments in Microwave Physics.—H. Severin. (*Naturwissenschaften*, May 1960, Vol. 47, No. 10, pp. 217–225.) Review dealing particularly with improved ferromagnetic and ferrimagnetic materials and semiconductors, and their applications in new microwave devices.

621.30.018.3 **2436**

Reliability of Electronic Equipment.—H. J. Feindt. (*Elektron. Z.*, Köln, Vol. 6, Feb. 1960, Vol. 41, No. 3, pp. 330–331.) A method of determining the operational reliability of complex equipment on the basis of the known failure rates of its components is described.

621.39 (067.1) **2437**

Communication Engineering and Radiolocation.—(*Fortschr. Hochfrequenztech.*, Vol. 3, 1960, Vol. 105, No. 5, pp. 189–205.) Progress report covering recent developments, with references mainly to German literature. The following sections are surveyed:

(*a*) Telecommunications.—W. Aßmus (pp. 189–191).

(*b*) Sound Broadcasting and Television.—K. Müller (pp. 191–194). 99 references.

(*c*) Radar and Radio Navigation.—W. Stanner (pp. 195–196).

(*d*) Electroacoustics.—H. Hase (pp. 197–200). 64 references.

(*e*) High-Frequency Measurements.—A. Egger (pp. 201–203). 65 references.

Abstracts and References

COMPILED BY THE RADIO RESEARCH ORGANISATION OF THE DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH AND PUBLISHED BY ARRANGEMENT WITH THAT DEPARTMENT

The abstracts are classified in accordance with the Universal Decimal Classification. They are arranged within broad subject sections in the order of the U.D.C. numbers, except that notices of book reviews are placed at the ends of the sections. U.D.C. numbers marked with a dagger (†) must be regarded as provisional. The abbreviations of journal titles conform generally with the style of the World List of Scientific Periodicals. An Author and Subject Index to the abstracts is published annually; it includes a list of journals abstracted, the abbreviations of their titles and their publishers' addresses. Copies of articles in journals referred to are not available from Electronic Technology. Application must be made to the individual publishers concerned.

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ACOUSTICS AND AUDIO FREQUENCIES

534.2: 530.145 **2438**

Quantum-Mechanical Many-Particle Treatment of Sound Propagation.—D. E. McCumber. (*Nuovo Cim.*, 1960, Vol. 17, Supplement No. 1, pp. 8–42. In English.)

534.23 **2439**

Synthesis of Stepped Acoustic Transmission Systems.—J. E. Holte & R. F. Lambert. (*J. acoust. Soc. Amer.*, March 1961, Vol. 33, No. 3, pp. 289–301.) Procedures are described enabling acoustic systems supporting one-dimensional harmonic waves to be synthesized for a prescribed frequency dependence of the input reflection coefficient, the characteristic impedance of the system being allowed to vary in steps.

534.232: 534.24 **2440**

Effect of a Reflecting Plane on an Arbitrarily Oriented Multipole.—D. A. Bies. (*J. acoust. Soc. Amer.*, March 1961, Vol. 33, No. 3, pp. 286–288.) General expressions for the acoustic power radiated by either a dipole or quadrupole oriented above an infinite rigid reflecting plane are derived.

534.232: 537.228.1 **2441**

Transients and the Equivalent Electrical Circuit of the Piezoelectric Transducer.—L. Filipczyński. (*Acustica*, 1960, Vol. 10, No. 3, pp. 149–154.) A transmission-line equivalent circuit is derived from an analysis of thickness vibrations of an X-cut quartz transducer.

534.18: 534.88 **2442**

Theoretical Development of Volume Reverberation on a First-Order Scattering Phenomenon.—H. B. Curtiss. (*J. acoust. Soc. Amer.*, March 1961, Vol. 33, No. 3, pp. 317–323.) A statistical distribution of scatterers described by a spatial correlation function leads to a representation of the reverberation by random noise passing through a narrow filter whose properties are determined by the transmission mode.

534.283-8: 537.311.31 **2443**

Ultrasonic Attenuation in Normal Metals at Low Temperatures.—A. B. Bhatia & R. A. Moore. (*Phys. Rev.*, 15th Feb. 1961, Vol. 121, No. 4, pp. 1075–1086.)

534.6: 621.374.5 **2444**

Acoustic Delay Line.—I. Ver. (*Frequenz*, Sept. 1960, Vol. 14, No. 9, pp. 317–321.) The system described has a continuously variable delay in the range 0–3 ms; it consists of pressure chambers coupled to microphones by metal tubing. The application of the delay line for the determination of noise correlation functions is illustrated.

534.6-8: 621.385.83: 537.228.1 **2445**

Ultrasonic Image Conversion with an Electron Mirror.—G. Koch. (*Acustica*, 1960, Vol. 10, No. 3, pp. 167–170. In German.) A development of the image converter is described [see e.g. 2084 of 1959 (Freitag & Martin)] in which slow electrons reflected from an oscillating quartz crystal in the ultrasonic field in a water tank containing the object are separated from the incident beam by means of a magnetic field. Contrast is greatest with moving objects.

534.6.087.2 **2446**

Ultrasonic Evaluation Equipment for Subjective Assessments.—G. Steinke, W. Wunner & J. Seydewitz. (*Tech. Hbk. BBP, Berlin*, Sept. 1960, Vol. 4, No. 3, pp. 85–88.) The apparatus described is designed for use in tests for assessing the quality of sound transmission systems.

534.75 **2447**

Loudness Function and Differential Sensitivity of the Intensity.—L. Barducci. (*Ricerca sci.*, Oct. 1960, Vol. 30, No. 10, pp. 1518–1523. In English.) The method proposed by Schiaffini (*Ann. Télécomm.*, Oct. 1957, Vol. 12, No. 10, pp. 349–358) for deducing the loudness function from experimental values of differential auditory sensitivity can be modified to agree with more recent data obtained e.g. by Robinson & Dadson (1947 of 1958).

534.76 **2448**

The Transmission of 'Room Information'.—K. Wendt. (*Rundfunktech. Mitt.*, Oct. 1960, Vol. 4, No. 5, pp. 209–212.) A two-channel sound transmission system is discussed, designed for the transmission of direct sound in addition to information relating to the acoustic quality of the room in which the sound originates. Measurements have been made of the optimum loudness for the information channel; this varies with the size and reverberation time of the room.

534.76: 621.396.97 **2449**

Subjective Evaluation of Factors Affecting Two-Channel Stereophony.—F. K. Harvey & M. R. Schroeder. (*J. audio Engng Soc.*, Jan. 1961, Vol. 9, No. 1, pp. 19–28.)

534.78: 621.376.22: 538.632 **2450**

A Correlator employing Hall Multipliers applied to the Analysis of Vocoder Control Signals.—J. N. Holmes & J. N. Shearme: A. R. Billings & D. J. Lloyd. (*Proc. Instn elect. Engrs*, Part B, March 1961, Vol. 108, No. 38, pp. 237–238.) Discussion of 4083 of 1960.

534.78: 621.391 **2451**

The Quantization of Speech in Few Stages.—W. Andrich. (*Nachrichtentech. Z.*, Aug. 1960, Vol. 13, No. 8, pp. 379–383.) Extension of earlier work [3855 of 1959 (Küpfmüller & Andrich)]. Measurements of logatom intelligibility are discussed; intelligibility can be improved for an even number of thresholds when noise is mixed with the speech before quantization.

534.833.1 **2452**

Measurement of the Sound Insulation by Random and by Normal Incidence of Sound.—E. Brosio. (*Acustica*, 1960, Vol. 10, No. 3, pp. 173–175. In English.) Experimental data on transmission loss measured for random and normal incidence are compared. Results support London's theory.

534.84 **2453**

The Construction and Acoustic Properties of the Large Anechoic Chamber in the B.R.F.—P. Schubert & J. Scholze. (*Tech. Mitt. BRF, Berlin*, Sept. 1960, Vol. 4, No. 3, pp. 101–112.) Full details are given of the materials used and construction procedure adopted; comparisons are made with results obtained in other anechoic chambers [e.g. 393 of February (Kraak et al.)].

534.846 **2454**

The Sound-Scattering Properties of Segments of Spheres and Cylinders on the Walls of Reverberation Chambers.—G. Venzke. (*Acustica*, 1960, Vol. 10, No. 3, pp. 170–172. In German.) Results are given of an experimental investigation based on measurements of the sound absorption coefficient of a large absorbing sheet in a reverberation chamber of 250 m^3 fitted with scattering elements.

621.395.614: 534.76.001.57 **2455**

Ultrasonic Microphones with Cardioid and Figure-of-Eight Patterns for M.S. Stereophony.—J. Bolch. (*Frequenz*, Sept. 1960, Vol. 14, No. 9, pp. 315–317.) The design of condenser microphones for use on acoustic model tests is described.

AERIALS AND TRANSMISSION LINES

621.372.2 **2456**

Electromagnetic-Field-Theory Solution of the Infinite Tapered-Plane Transmission Line.—N. Amitay, A. Lavi & F. Young. (*Z. angew. Math. Phys.*, 25th March 1961, Vol. 12, No. 2, pp. 89–99. In English.) The mathematical technique used is based on the exact solution in e.m. field theory of the oblique-plane transmission line, in conjunction with Lagrange's method of variation of parameters.

621.372.8: 537.525 **2457**

A Gas-Discharge Microwave Power Coupler.—R. W. Otthus. (*Proc. Inst. Radio Engrs*, May 1961, Vol. 49, No. 5, Part 1, pp. 949–956.) A cylindrical resonator having a gas-discharge tube along its axis has power coupled into it in a mode with E transverse to the axis. A probe extracts power in a transverse mode with E normal to the first mode. Coupling takes place only when an axial magnetic field is present.

621.372.8: 621.39 **2458**

Long-Distance Waveguide Transmission.—R. Hamer. (*Electronic Engng*, April & May 1961, Vol. 33, Nos. 398 & 399, pp. 218–225 & 279–283.) The feasibility of long-distance circular-waveguide (H_{01}-wave) transmission using f.m. is examined, on the assumptions that a special waveguide structure is provided and that waveguide imperfections are random. The analysis is made with particular reference to multichannel telephony. Results are applied to a hypothetical route; the limitations examined do not preclude the use of f.m. in long-distance circular-waveguide transmission.

621.372.829: 621.374.5 **2459**

The Helix as Delay Line.—G. Piefke. (*Nachrichtentech. Z.*, Aug. 1960, Vol. 13, No. 8, pp. 370–374.) Treatment of the helix waveguide as a delay line on the basis of earlier work (e.g. 27 of January).

621.372.837: 621.375.9: 538.569.4 **2460**

Use of a Y-Type Circulator Switch with a 21-Centimetre Maser Radiometer.—B. F. C. Cooper. (*Rev. sci. Instrum.*, Feb. 1961, Vol. 32, No. 2, pp. 202–203.) The switch eliminates base-line drifts observed with an automatic gain stabilization system (see 2521 below).

621.372.85.017.7: 538.569.3 **2461**

The Heating Process in Circular Dielectric Disks in the High-Frequency Field of H_{0n}-Mode Waveguides.—H. Buchholz. (*Arch. Elektrotech.*, 12th Dec. 1960, Vol. 45, No. 7, pp. 447–465.) Green's function of thermal conduction is used in calculating exactly the internal heating of lossy dielectrics in a high-frequency e.m. field.

621.372.852.15 **2462**

Matched, Tunable Cavities as Circuit Elements of Waveguide Filters. II.—H. Urbanz. (*Nachrichtentech. Z.*, Aug. 1960, Vol. 13, No. 8, pp. 383–391.) Investigation of design and construction problems relating to tunable cavities formed by inductive or capacitive obstacles in rectangular waveguide. Design charts are derived from equivalent circuits. Bandwidth variations during tuning are determined on the basis of the charts, and are confirmed by results of measurements.

621.372.852.323 **2463**

Millimetre-Wave Field-Displacement-Type Isolators with Short Ferrite Strips.—K. Ishii, J. B. Y. Tsui & F. F. Y. Wang. (*Proc. Inst. Radio Engrs*, May 1961, Vol. 49, No. 5, Part 1, pp. 975–976.) Attenuation of 35 dB (backward) and 1 dB (forward) was obtained with a 0·2-in. single-crystal strip.

621.372.852.5 **2464**

Mode Conversion in the Excitation of TE_{01} Waves in a TE_{01}-Mode Transducer (Rectangular→Sector Portion→Circular).—S. Iiguchi. (*Rev. elect. Commun. Lab., Japan*, July/Aug. 1960, Vol. 8, Nos. 7/8, pp. 324–334.) Expressions for the transverse fields in the cross-sections of the transducer are expanded into a series of normal-mode functions of sector waveguides, and by substitution into Maxwell's equations expressed in oblique coordinates, the theoretical magnitudes of the unused TE_{11}, TE_{21}, TE_{31}, and TM_{11} modes are obtained. Experimental values agree to within 1 dB.

621.372.853.1.002.2 **2465**

Dielectric-Coated Waveguide Construction Characteristics.—K. Noda & K. Yamaguchi. (*Rev. elect. Commun. Lab., Japan*, July/Aug. 1960, Vol. 8, Nos. 7/8, pp. 309–323.) Several different techniques are described and the theoretical attenuation increase due to the coating is calculated.

621.372.853.3: 537.56 **2466**

Perturbation Method for the Propagation of Electromagnetic Waves in a Plasma Partially Filling a Circular Waveguide.—L. Cairó. (*C. R. Acad. Sci., Paris*, 20th June 1960, Vol. 250, No. 25, pp. 4129–4131.) A relation is found between the value of the propagation constant and the diameters of the two concentric tubes of a waveguide, the plasma being contained in the inner tube.

621.396.67 **2467**

Development of Optimum Wide-Band Omnidirectional Aerials.—H. G. Wahsweiler. (*Z. angew. Phys.*, Oct. 1960, Vol. 12, No. 10, pp. 450–461.) Detailed treatment of the design of radiators of rotational symmetry, covering a range of aperture angles and including an investigation of their polar diagrams. For another treatment of a similar problem see 1418 of May (Meinke).

621.396.677: 621.396.963.3 **2468**

A Fast Electronically Scanned Radar Receiving System.—Davies. (See 2614.)

621.396.677.012.12: 621.317.3 **2469**

Field Pattern Measurements of Various H.F. Directional Aerials using Aircraft.—R. T. Rye. (*Proc. Instn Radio Engrs, Aust.*, Dec. 1960, Vol. 21, No. 12, pp. 879–885.) Horizontally arrayed dipoles, rhombic, sloping-V and Franklin aerials were investigated, giving the performance at the design frequencies, the off-frequency performance of a horizontally arrayed dipole and information on aerial interaction effects.

621.396.677.3 **2470**

Backward-Wave Radiation from Periodic Structures and Application to the Design of Frequency-Independent Antennas.—P. E. Mayes, G. A. Deschamps

& W. T. Patton. (*Proc. Inst. Radio Engrs*, May 1961, Vol. 49, No. 5, Part 1, pp. 962–963.) The aerial is considered as a locally periodic structure whose period varies slowly, increasing linearly with the distance to the apex.

621.396.677.3.012.12 (083.5) **2471**

Tables of Horizontal Radiation Patterns of Dipoles Mounted on Cylinders.—P. Knight & R. E. Davies. (*B.B.C. Engng Div. Monographs*, Feb. 1961, No. 35, pp. 5–41.) A comprehensive range of mast sizes and dipole spacings has been covered.

621.396.677.4 **2472**

Long-Wire Antenna for Meteor-Burst Communications.—D. K. Reynolds & J. M. Bartlemay. (*Electronics*, 24th March 1961, Vol. 34, No. 12, pp. 40–42.) A simple long-wire aerial system for use in the 30–100 Mc/s range is described.

621.396.677.7: 621.372.823 **2473**

Investigation of the Radiation Characteristics of Elliptical Waveguide and of the Possibility of Generating a Circularly Polarized Radiation Field.—K. E. Müller. (*Hochfrequenztech. u. Elektroakust.*, Aug. 1960, Vol. 69, No. 4, pp. 140–151.) Addition to earlier work on open waveguides (3959 of 1959).

621.396.677.81.012.12 **2474**

Directivity Diagrams in the Horizontal Plane of a Vertical Dipole in the Presence of a Parallel Cylindrical Parasitic Element.—H. Baret. (*Ann. Télécommun.*, Sept./Oct. 1959, Vol. 14, Nos. 9/10, pp. 220–235.) Directivity diagrams are calculated by a method due to Hallén in which a sinusoidal current distribution is not assumed *a priori*. Results are in good agreement with those calculated by other methods.

621.396.677.833: 621.396.65 **2475**

Development of Radio-Link Aerials for the 4 000-Mc/s Band.—J. A. C. Jackson. (*Marconi Rev.*, 1st Quarter 1961, Vol. 24, No. 140, pp. 26–38.) Paraboloid aerials of 6ft and 10ft diameter are described, having efficiencies of 58% and 63% and gains of 35 dB and 39 dB respectively. The impedance match of the complete aerials gives a voltage s.w.r. better than 0·95 over a 400-Mc/s band when using a flanged waveguide feed; other types of feed are discussed.

621.396.677.85 **2476**

Lens-Compensated Biconical Aerial.—L. Solymar. (*Electronic Technol.*, June 1961, Vol. 38, No. 6, pp. 211–213.) The radiation pattern is calculated and a practical example is worked out to show the design procedure for a lens of polystyrene or plexiglass if the half-power points are given.

621.396.679.4: 621.372.43 **2477**

***p-i-n* Diodes control Shorted Stub.**—R. H. Mattson. (*Electronics*, 7th April 1961, Vol. 34, No. 14, pp. 76–77.) The length of a shorted stub for matching in the range 225–600 Mc/s can be altered electronically by opening or closing diode switches mounted at intervals along the stub.

621.396.679.4: 621.372.8 : 621.317.333.4 **2478**

A Swept-Frequency Method of Locating Faults in Waveguide Aerial Feeders.—J. Hooper. (*P.O. elect. Engrs' J.*, April 1961, Vol. 54, Part 1, pp. 27–30.) A rapid 400-Mc/s sweep obtained from a carcinotron in the band 2 500–4 500 Mc/s enables discontinuities having reflection coefficients exceeding 0·005 to be located to a positional accuracy within 2% at distances up to 300 ft.

AUTOMATIC COMPUTERS

681.142 **2479**

Accuracy and Limitations of the Resistor Network used for Solving Laplace's and Poisson's Equations.—J. R. Hechtel & J. A. Seeger. (*Proc. Inst. Radio Engrs*, May 1961, Vol. 49, No. 5, Part 1, pp. 933–940.) The accuracy of a resistor network is higher than that of the best comparable electrolyte tank. Improved methods of simulating boundary conditions are described.

681.142 **2480**

Storing Decimal Digits with One Clock Pulse.—A. A. Jaecklin. (*Electronics*, 17th March 1961, Vol. 34, No. 11, pp. 50–53.) A method based on the magnetization time of ferrite cores.

681.142 **2481**

Transistorized Electronic Analogue Multiplier.—S. Deb & J. K. Sen. (*Rev. sci. Instrum.*, Feb. 1961, Vol. 32, No. 2, pp. 189–192.) A four-quadrant circuit using the exponential I/V characteristics of the input of grounded-base junction transistors is described. The performance compares favourably with that of other types.

681.142: 538.221 **2482**

Solving Design Problems in All-Magnetic Logic.—U. F. Gianola. (*Electronics*, 5th May 1961, Vol. 34, No. 18, pp. 61–66.) A survey of general problems and methods of design of magnetic logic circuits excluding parametron and ferroresonant circuits.

681.142: 621-52 **2483**

Discrete Analogue-Computer Compensation of Sampled-Data Control Systems.—T. Glucharoff. (*Proc. Instn elect. Engrs*, Part B, March 1961, Vol. 108, No. 38, pp. 167–176. Discussion, pp. 176–179.) A description of operational amplifiers and Si-diode switches for performing the basic functions of sampling, holding, and time delay. Performance is analysed, and an arrangement for avoiding saturation in a feedback system is also described.

CIRCUITS AND CIRCUIT ELEMENTS

621.316.86: 539.23 **2484**

Tin Oxide Resistors.—R. H. W. Burkett. (*J. Brit. Instn Radio Engrs*, April 1961, Vol. 21, No. 4, pp. 301–304.) The characteristics of thin oxide films are discussed and techniques of manufacture and performance figures of tin oxide resistors for various applications are given.

621.318.57: 523.164 **2485**

R.F. Switching Circuits and Hybrid Ring Circuits used in Radio Astronomy.—F. G. Smith. (*Proc. Instn elect. Engrs*, Part B, March 1961, Vol. 108, No. 38, pp. 201–204.) Low-loss diode and other switching systems used in comparing small r.f. noise powers are described.

621.318.57: 621.382.333.33 **2486**

Designing Avalanche Switching Circuits.—Rufer. (See 2810.)

621.372.4 **2487**

The Equivalent Wave Source.—H. J. Butterweck. (*Arch. elekt. Übertragung*, Sept. 1960, Vol. 14, No. 9, pp. 367–372.) The application of wave parameters to two-terminal sources is discussed. An equivalent wave source is derived which corresponds to the conventional equivalent voltage or current source.

621.372.4: 621.3.024 **2488**

The Law of Small Variations in Characteristics and its Application to Nonlinear and Linear Networks.—E. Schwartz. (*Arch. elekt. Übertragung*, Sept. 1960, Vol. 14, No. 9, pp. 405–410.) Current changes resulting from small variations in characteristics in nonlinear d.c. networks can be calculated approximately by reference to an equivalent circuit. Examples of linear networks considered are a Wheatstone bridge circuit and reactance two-poles.

621.372.41 **2489**

The Realizability Conditions for the Impedance Functions of Electrical Two-Pole Networks allowing for Losses in Coils and Capacitors.—F. H. Effertz & W. Meuffels. (*Arch. Elektrotech.*, 14th Oct. 1960, Vol. 45, No. 6, pp. 418–428.)

621.372.5 **2490**

Some Energy Relations for *RC* Networks.—A. H. Zemanian. (*J. Franklin Inst.*, Nov. 1960, Vol. 270, No. 5, pp. 353–358.) Certain relations are established and associated with the compact *RC* network whose open-circuit impedance parameters have residues that possess the same ratio at corresponding poles.

621.372.5 **2491**

Non-ideal Gyrators.—K. H. R. Weber. (*Nachr Tech.*, Aug. 1960, Vol. 10, No. 8, pp. 334–339.) The analogy between non-ideal gyrators and non-ideal transformers is established. Equations are derived for the "perfect" gyrator and the gyrator with leakage; matching and directional characteristics are discussed.

621.372.54 **2492**

The Effect of Tolerances in the Elements of Image-Parameter Filters.—J. W. Scholten. (*Philips Telecommun. Rev.*, Jun. 1961, Vol. 22, No. 2, pp. 63–77.)

621.372.54: 534.143 **2493**

The Insertion Characteristics of Cascaded Circuits.—W. Herzog. (*Nach-*

richtentech. Z., Sept. 1960, Vol. 13, No. 9, pp. 424–427.) A method of dealing with series-connected filter circuits, in particular those consisting of electromechanical elements, is considered. A single quadripole is derived to represent a cascade-connected equal and symmetrical quadripoles, and different types of end-section are added to this equivalent quadripole. The impedance matrix of the equivalent network is determined; the application of the principle to a combination of unequal quadripoles is outlined.

621.372.54 : 537.228.1 **2494**

Piezoelectric Ceramic Transformers and Filters.—A. E. Crawford. (*J. Brit. Instn Radio Engrs*, April 1961, Vol. 21, No. 4, pp. 353–360. Discussion.) A description of some of the types of transformers and filters which are produced from the lead zirconate-lead titanate series.

621.372.54 : 538.652 **2495**

Magnetostrictive Transducers as Selective Quadripoles.—C. Kurth. (*Frequenz*, Aug. 1960, Vol. 14, No. 8, pp. 272–288.) The relations between electrical and mechanical quantities in magnetostrictive energy transducers are given and equivalent circuits derived. Design formulae are obtained using image-parameter theory. See also 4135 of 1960.

621.372.543.2 **2496**

Some Comments on Narrow Band-Pass Filters.—M. Rosenblatt. (*Quart. appl. Math.*, Jan. 1961, Vol. 18, No. 4, pp. 387–393.)

621.372.543.2 : 534.143 **2497**

The Measurement of the Characteristic Values of Electromechanical Coupling Filters.—E. Trzeba. (*Hochfrequenztech. u. Elektroakust.*, Aug. 1960, Vol. 69, No. 4, pp. 119–123.) See also 2122 of July.

621.372.55 : 621.397 **2498**

Quadripole Networks for Phase Correction in Low-Pass and Band-Pass Amplifiers.—G. Goldewey. (*Frequenz*, Sept. 1960, Vol. 14, No. 9, pp. 299–305.) The design of delay equalizers for television transmission systems is described.

621.372.552 **2499**

Bode's Variable Equalizer.—S. S. Hakim. (*Electronic Technol.*, June 1961, Vol. 38, No. 6, pp. 224–227.) Design procedure for an equalizer in which the insertion-loss characteristic can be varied by the variation of one network element (a thermistor) is developed from basic theory.

621.372.6 **2500**

Coupling of Multipoles represented as a Wave-Transmission Problem.—G. Salzmann. (*NachrTech.*, Aug. 1960, Vol. 10, No. 8, pp. 353–355.) The method of solving multipole coupling problems by means of a scattering matrix is described.

621.372.6 **2501**

Network Synthesis with Negative Resistors.—H. J. Carlin & D. C. Youla. (*Proc. Inst. Radio Engrs*, May 1961, Vol. 49, No. 5, Part 1, pp. 907–920.) The theory is presented of the incorporation of the negative resistor as a basic circuit element in problems of linear network analysis and synthesis. Nine circuit theorems are given.

621.373.029.6 **2502**

Note on Coherence vs Narrowbandedness in Regenerative Oscillators, Masers, Lasers, etc.—M. J. E. Golay. (*Proc. Inst. Radio Engrs*, May 1961, Vol. 49, No. 5, Part 1, pp. 958–959.)

621.373.42 : 621.317.77 **2503**

A Method for Generating Signals of Arbitrary yet Frequency-Independent Phase Differences.—O. K. Nilsen. (*Proc. Inst. Radio Engrs*, May 1961, Vol. 49, No. 5, Part 1, pp. 964–965.) Two balanced-peak detectors are used. The phase difference remains constant over a range 10 c/s–1 kc/s.

621.373.42.072.6 : 621.376.32 **2504**

Improvement of the Frequency Stability of a High-Frequency Oscillator Frequency-Modulated by means of a Condenser Microphone.—H. Maier. (*Nachrichtentech. Z.*, Sept. 1960, Vol. 12, No. 9, pp. 436–440.) A frequency-stabilizing system is described in which the condenser microphone serves simultaneously for frequency modulation and as an a.s. control element. The system finds application in miniature v.h.f. transmitters and eliminates the need for crystal control.

621.373.421.11 : 621.374.32 **2505**

High-Frequency Oscillator Stabilization by Pulse Counting Techniques.—R. P. Thatte. (*J. Brit. Instn Radio Engrs*, April 1961, Vol. 21, No. 4, pp. 361–373. Discussion.) A system is described for frequency stabilization to within 5 parts in 10^9 in the range 2–30 Mc/s, using an *LC* tuned oscillator locked to a standard frequency. A description of the trochotron divider used in the circuit is given.

621.373.421.13 : 529.786 **2506**

Quality Measurements on Oscillator Crystals by the Decay Method.—G. Becker. (*Frequenz*, Aug. 1960, Vol. 14, No. 8, pp. 269–271.) Equipment is described for measuring the time constant of the decay of free oscillations of quartz oscillators. The method is suitable for measuring the *Q*-factor of crystals of high resonance frequency.

621.373.43 : 621.374.4 **2507**

8- and 11-Gc/s Nanosecond Carrier Pulses produced by Harmonic Generation.—A. F. Dietrich. (*Proc. Inst. Radio Engrs*, May 1961, Vol. 49, No. 5, Part 1, pp. 972–973.) Pulses are generated directly from the harmonics present in the sharp step at the end of the recovery transient of a selected Type-FD-100 diode which is mounted across a waveguide used as a high-pass filter.

621.373.43 : 621.385.632 **2508**

A Simple Method of Generating Nanosecond Pulses at X Band.—J. K. Pulfer & B. G. Whitford. (*Proc. Inst. Radio Engrs*, May 1961, Vol. 49, No. 5, Part 1, p. 968.) The technique is based on the pulse response of a travelling-wave tube.

621.374.33 : 621.318.57 : 621.372.44 **2509**

Magnetic Gate Circuits Controlled by High-Frequency Signals.—I. Endo & K. Kumaoki. (*Rev. elect. Commun. Lab., Japan*, July/Aug. 1960, Vol. 8, Nos. 7/8, pp. 335–342.) Principles of operation of three- and four-core gating circuits based on the nonlinear properties of parametron-type cores are described. Experimental characteristics and applications are noted.

621.374.4 : 621.372.44 **2510**

High-Efficiency Variable-Reactance Frequency Multiplier.—T. Utsunomiya & S. Yuan. (*Proc. Inst. Radio Engrs*, May 1961, Vol. 49, No. 5, Part 1, p. 965.) A conversion efficiency of 40% was obtained using variable-capacitance diodes with input frequency of 0·84 Mc/s and output frequency 12·6 Mc/s.

621.374.5 **2511**

Stabilized Delay Circuit Provides High Accuracy.—C. K. Friend & S. Udalov. (*Electronics*, 14th April 1961, Vol. 34, No. 15, pp. 78, 80.) A transistorized circuit is given providing delays up to 120 μs with a high degree of accuracy and stability.

621.374.5 : 621.382.333.33 **2512**

Electrically Variable Time Delay using Cascaded Drift Transistors.—R. W. Ahrons. (*Semiconductor Prod.*, March 1961, Vol. 4, No. 3, pp. 37–40.) Eight cascaded transistors provide a variation of delay of 0–11μs with a minimum cut-off frequency of 5 Mc/s.

621.375 : 621.372.44 : 621.372.632 **2513**

Parametric Up-Converter Tunable over an 18 : 1 Frequency Band.—G. P. Shepherd & D. G. Kiely. (*Proc. Inst. Radio Engrs*, May 1961, Vol. 49, No. 5, Part 1, p. 966.) By using an adjustable X-band pump frequency, a gain of 5–12 dB is obtained with signal frequencies ranging from 100 to 1 800 Mc/s.

621.375.018.756 **2514**

Two Simple Estimates for Overshoot and Group Delay.—H. Sulanke & H. Dobesch. (*Tech. Mitt. RRF, Berlin*, Sept. 1960, Vol. 4, No. 3, pp. 83–85.) Approximations relating to the transient response of cascade-connected quadripoles. See also 467 of February (Dobesch & Sulanke).

621.375.029.64/.65 : 621.38 **2515**

Low-Noise Amplifiers for Centimetre and Shorter Wavelengths.—G. Wade. (*Proc. Inst. Radio Engrs*, May 1961, Vol. 49, No. 5, Part 1, pp. 890–891.) A summary of the techniques used to make low-noise amplifiers. The devices covered are travelling-wave tubes, parametric amplifiers, tunnel diodes, masers, photon counters and photoemitive detectors.

621.375.4 **2516**

Calculations of Distortion and Interference Effects in Transistor Amplifier Stages on the Basis of the Equivalent Circuit Diagram.—J. S. Vogel & M. J. O. Strutt. (*Arch. elekt. Übertragung*, Sept. 1960, Vol. 14, No. 9, pp. 397–404.) Low-frequency conditions and input signals up to maximum permissible amplitude are considered, and

the calculations are applied to two-stage circuits. The extension of the theory to high-frequency conditions is indicated.

621.375.4 2507

Improving Gain Control of Transistor Amplifiers.—J. S. Brown. (*Electronics*, 26th April 1961, Vol. 34, No. 17, pp. 108–110.) Better temperature stability and a lower noise figure are obtained by using separate a.g.c. loops for each stage.

621.375.9: 538.569.4 2508

Proposal for a Pulsed Ferromagnetic Microwave Generator.—M. W. Muller. (*Proc. Inst. Radio Engrs*, May 1961, Vol. 49, No. 5, Part 1, p. 957.) Spin precession is induced by rotating the applied field from a metastable to a stable magnetizing direction.

621.375.9: 538.569.4 2509

Stimulated Emission from HCN Gas Maser Observed at 88.6 kMc/s.—D. Marcuse. (*J. appl. Phys.*, April 1961, Vol. 32, No. 4, p. 743.) HCN is considered as an alternative to NH_3 for a gas maser. The relative position and strength of the absorption lines are shown, and the construction of the proposed maser is described.

621.375.9: 538.569.4 2510

Beam Maser for 3 Millimetres uses Hydrogen Cyanide.—F. S. Barnes & D. Maley. (*Electronics*, 17th March 1961, Vol. 34, No. 11, pp. 45–49.) A practical description of the development and construction of a maser operating at 88 Gc/s which may be useful as a power source, amplifier, or as a frequency standard.

621.375.9: 538.569.4: 523.164 2511

An Operational Ruby Maser for Observations at 21 Centimetres with a 60-Foot Radio Telescope.—J. V. Jelley & B. F. C. Cooper. (*Rev. sci. Instrum.*, Feb. 1961, Vol. 32, No. 2, pp. 166–175.) Details are given of a preamplifier, weight 200 lb, for mounting at the focus of a 60-ft reflector. An automatic gain stabilization system is incorporated. Total input noise temperature of the radiometer is 85 K with gain stabilization, and 160 K without.

621.375.9: 621.372.44 2512

A Variable-Dual-Reactance Travelling-Wave Parametric Amplifier.—R. D. Wanselow. (*Proc. Inst. Radio Engrs*, May 1961, Vol. 49, No. 5, Part 1, p. 973.) Two transmission lines are coupled together by inductance and capacitance which vary at a pump frequency.

621.375.9: 621.372.44: 538.221 2513

K_u-Band Ferrite Amplifier.—R. W. Roberts. (*Proc. Inst. Radio Engrs*, May 1961, Vol. 49, No. 5, Part 1, p. 963.) A parametric amplifier using a sphere of Y-Fe garnet and giving 10 dB gain at 20·8 Gc/s.

621.375.9: 621.372.44: 621.382.23 2514

Parametric Amplification by Charge Storage.—D. L. Hedderly. (*Proc. Inst. Radio Engrs*, May 1961, Vol. 49, No. 5, Part 1, pp. 966–967.) Both parametric amplification and subharmonic oscillation can be obtained through charge storage effects, using the circuit described.

621.375.9: 621.372.44: 621.382.23 2515

C-Band Nondegenerate Parametric Amplifier with 500-Mc/s Bandwidth.—J. Klipfunic. (*Proc. Inst. Radio Engrs*, May 1961, Vol. 49, No. 5, Part 1, p. 961.) The amplifier uses two Si pill varactor diodes in a balanced circuit, and has a gain of 10 dB.

621.375.9: 621.372.44: 621.382.33 2516

Parametric-Excited Resonator using Junction Transistor.—Y. Cho. (*Proc. Inst. Radio Engrs*, May 1961, Vol. 49, No. 5, Part 1, p. 934.) Oscillations in the collector circuit are phase-locked by a signal applied to the reverse-biased emitter.

621.375.9: 621.382.23 2517

A Matched Amplifier using Two Cascaded Esaki Diodes.—D. R. Hamann. (*Proc. Inst. Radio Engrs*, May 1961, Vol. 49, No. 5, Part 1, pp. 934–936.) A circuit consisting of a quarter-wave transmission line whose ends are terminated by negative conductances is discussed and its characteristics calculated. A 30-Mc/s amplifier using two Esaki diodes has been found to have a gain of 8·9 dB with a noise figure of 4·3 dB.

GENERAL PHYSICS

530.12 2518

General Relativity for the Experimentalist.—R. L. Forward. (*Proc. Inst. Radio Engrs*, May 1961, Vol. 49, No. 5, Part 1, pp. 892–904.)

530.162 2519

Direct Determination of Boltzmann's Constant from Resistance Noise.—L. Storm. (*Naturwissenschaften*, Nov. 1960, Vol. 47, No. 21, p. 490.) The value of k obtained from thermal-noise measurements in the frequency range 2–20 kc/s is $1{\cdot}38059 \times 10^{-23}$ joules/degree, to an accuracy within ±0·12%.

537.311.1 2520

Friedel Sum Rule for a System of Interacting Electrons.—J. S. Langer & V. Ambegaokar. (*Phys. Rev.*, 15th Feb. 1961, Vol. 121, No. 4, pp. 1090–1092.)

537.312.8 2521

Theory of the Magnetoresistance Effect.—J. Hajdu. (*Z. Phys.*, 14th Sept. & 22nd Nov. 1960, Vol. 160, Nos. 1 & 5, pp. 47–58 & 481–490 and 10th May 1961, Vol. 163, No. 1, pp. 108–118.) Magnetoresistance effects in metals are studied on the basis of a single quantum theory of electron transport in a magnetic field.

537.32 2522

Response of a Thermocouple Circuit to Non-steady Currents.—T. T. Arai & J. R. Madigan. (*J. appl. Phys.*, April 1961, Vol. 32, No. 4, pp. 609–616.) A general expression for the transient response is derived and applied to several special forms of time-dependent current.

537.533 2523

Note on the Mechanism of the Multipactor Effect.—F. Paschke. (*J. appl. Phys.*, April 1961, Vol. 32, No. 4, pp. 747–748.) By modifying the theory of Krebs & Moorbach (2913 of 1955) to take into account the velocity distribution of secondary electrons and the phase-defocusing effect, excellent agreement is obtained with the experimental results of Hatch & Williams (2629 of 1954).

537.56 2524

Determining Electron Density and Distribution in Plasmas.—H. L. Bunn. (*Electronics*, 7th April 1961, Vol. 34, No. 14, pp. 71–75.) A microwave interferometer technique is used for measurements on low-temperature magnetically contained plasmas.

537.56 2525

Transport Coefficients of Plasmas in a Magnetic Field.—S. Kaneko. (*J. phys. Soc. Japan*, Sept. 1960, Vol. 15, No. 9, pp. 1685–1696.) The electrical and thermal conductivities, and the coefficient of thermal diffusion are calculated.

537.56: 538.566 2526

Proposed Diagnostic Method for Cylindrical Plasmas.—J. Shmoys. (*J. appl. Phys.*, April 1961, Vol. 32, No. 4, pp. 689–695.) Expressions are derived for two methods whereby the electron density variation across a plasma column can be obtained more easily than hitherto from an observed diffraction pattern.

537.56: 538.566.029.6 2527

Microwave Attenuation by Cyclotron Resonance in a Slightly Ionized Gas.—T. Dodo. (*J. phys. Soc. Japan*, Feb. 1961, Vol. 16, No. 2, pp. 293–301.) The Boltzmann equation is solved for the distribution function of electrons in a static magnetic field B and a h.f. electric field. The tensor dielectric constant and propagation constant k are hence obtained. The attenuation spectrum is discussed for the two cases of k parallel and perpendicular to B.

537.56: 538.566.029.6 2528

Spectrum of the Electron Synchrotron Resonance in a Plasma.—T. Dodo. (*J. phys. Soc. Japan*, Feb. 1961, Vol. 16, No. 2, pp. 348–349.) Experimental verification of a theoretical formula for cyclotron resonance frequency (see 2527 above).

537.56: 538.566.029.6 2529

Heating of an Ionized Gas Sheath by Microwaves.—M. S. Sodha. (*Appl. sci. Res.*, 1960, Vol. B8, No. 3, pp. 208–212.) Formulae are derived from which the temperature of a plasma sheath can be found as a function of time, when it is heated by high-energy microwave radiation.

537.56: 538.566.029.6 2540

Backward-Wave Microwave Oscillations in a System Composed of an Electron Beam and a Hydrogen Gas Plasma.—R. Targ & L. P. Levine. (*J. appl. Phys.*, April 1961, Vol. 32, No. 4, pp. 731–737.) A travelling-wave interaction structure is used to investigate the properties of a low-density plasma. Microwave oscillations near the electron cyclotron frequency are observed as the result of growing waves in a beam/plasma interaction. Electron

densities determined by observing the correlation between the measured frequencies of oscillation and the theoretical predictions of Trivelpiece & Gould (815 of 1960) are verified by observation of the shift in the resonance frequency of a microwave cavity containing the plasma.

537.56: 621.372.8 **2541**

The Influence of the Cross-Sectional Distribution of Electron Density of a Longitudinally Magnetized Plasma in a Metal Waveguide on the Propagation of E.M. Waves.—W. O. Schumann. (*Z. angew. Phys.*, Oct. 1960, Vol. 12, No. 10, pp. 447–448.)

538.122: 538.221 **2542**

The Magnetization and Field of Rod-Shaped Objects.—G. Obermair & C. Schwink. (*Z. Phys.*, 20th Oct. 1960, Vol. 160, No. 3, pp. 268–276.) The magnetization process is analysed and general formulae are given for the demagnetizing field. An electron-optical method [3441 of 1959 (Schwink & Murrman)] for determining the magnetic distribution in and around the rod is discussed.

538.311 **2543**

Determination of the Energy of a Plane Magnetic Field by Representation of the Latter in an Electric Current Field.—F. Stier. (*Arch. Elektrotech.*, 30th Aug. 1960, Vol. 45, No. 5, pp. 343–346.)

538.311: 621.374 **2544**

Equipment for Generating Strong Magnetic Fields of Short-Period Constancy.—J. Durand, O. Klüber & H. Wulff. (*Z. angew. Phys.*, Sept. 1960, Vol. 12, No. 9, pp. 385–393.) A suitably terminated low-pass filter network is used to produce flat-topped current pulses for generating strong magnetic fields which are constant for periods of the order of 2 ms.

538.566 **2545**

A Dipole Absorber for Centimetric Electromagnetic Waves with Reduced Reflection at Oblique Incidence.—G. Kurtze & E. G. Neumann. (*Z. angew. Phys.*, Sept. 1960, Vol. 12, No. 9, pp. 385–393.) The addition to a resonance absorber of arrays of dipoles parallel and perpendicular to the absorber surface minimizes reflection at oblique incidence; experimental results and theory are given.

538.566: 535.43 **2546**

Multiple Scattering by a Random Stack of Dielectric Slabs.—I. Kay & R. A. Silverman. (*Nuovo Cim.*, 1958, Vol. 9, Supplement No. 2, pp. 626–645. In English.) When the number of slabs is large, the Neumann series for the mean square transmission and reflection coefficients converges much more rapidly than would be inferred from the smallness of the perturbation of the incident field by the scattering medium.

538.569.4 **2547**

Detection of Double Resonance by Frequency Change: Application to Hg^{201}.—R. H. Kohler. (*Phys. Rev.*, 15th Feb. 1961, Vol. 121, No. 4, pp. 1104–1111.)

538.569.4: 535.33: 621.375.9 **2548**

The Three-Level Gas Maser as a Microwave Spectrometer.—T. Yajima & K. Shimoda. (*J. phys. Soc. Japan*, Sept. 1960, Vol. 15, No. 9, pp. 1668–1675.) A method of microwave spectroscopy using three-level maser action is described and results of experiments on $^{14}NO_2$ are discussed in relation to theory. See also 1461 of May (Shimoda et al.).

538.569.4: 538.221 **2549**

Distribution of Fields from Randomly Placed Dipoles: Free-Precession Signal Decay as Result of Magnetic Grains.—R. J. S. Brown. (*Phys. Rev.*, 1st March 1961, Vol. 121, No. 5, pp. 1379–1382.)

538.569.4: 538.221 **2550**

Ferromagnetic Relaxation caused by Interaction with Thermally Excited Magnons.—E. Schlömann. (*Phys. Rev.*, 1st March 1961, Vol. 121, No. 5, pp. 1312–1319.)

538.569.4: 538.221 **2551**

Note on the Back-Reaction Term in Ferromagnetic Relaxation Equations.—H. Callen. (*J. appl. Phys.*, April 1961, Vol. 32, No. 4, p. 738.) A clarification is given of the status of the last term of the equation $\dot{s}_0 = -\lambda_{xx}s_0 + \lambda_{xx}\delta_0$, proposed in a paper on the analysis of ferromagnetic resonance line width in ferrites (3901 of 1958).

538.569.4: 538.222 **2552**

On the Theory of Spin-Lattice Relaxation in Paramagnetic Salts.—R. Orbach. (*Proc. phys. Soc.*, 1st April 1961, Vol. 77, No. 496, pp. 821–826.)

538.569.4: 621.375.9: 535.61-2 **2553**

Spatial Coherence in the Output of an Optical Maser.—D. F. Nelson & R. J. Collins. (*J. appl. Phys.*, April 1961, Vol. 32, No. 4, pp. 739–740.)

538.569.4: 621.375.9: 535.61-2 **2554**

Optically Efficient Ruby Laser Pump.—P. A. Miles & H. E. Edgerton. (*J. appl. Phys.*, April 1961, Vol. 32, No. 4, pp. 740–741.)

GEOPHYSICAL AND EXTRATERRESTRIAL PHENOMENA

523.14: 538.69 **2555**

Note on the Magnetic Structure of the Galaxy.—F. Hoyle & J. G. Ireland. (*Mon. Not. R. astr. Soc.*, 1961, Vol. 122, No. 1, pp. 35–39.) A reassessment of earlier theory (see 843 of March).

523.164 **2556**

A Comparison of Three Surveys of Radio Stars.—A. S. Bennett & F. G. Smith. (*Mon. Not. R. astr. Soc.*, 1961, Vol. 122, No. 1, pp. 71–77.) A recent survey of radio stars is compared with results of earlier measurements by Mills et al. (423 of 1959) and Edge et al. (*Mem. R. astr. Soc.*,1959, Vol. 68, Part 2, pp. 37–60).

523.164 **2557**

First Results of Radio Star Observations using the Method of Aperture Synthesis.—P. F. Scott, M. Ryle & A. Hewish. (*Mon. Not. R. astr. Soc.*, March 1961, Vol. 122, No. 2, pp. 95–114.) Four surveys, centred on declinations of 52°, 30°, 67° and 03° have been made at a wavelength of 1·7 m with a large interferometric radio telescope based on the technique of aperture synthesis [3726 of 1960 (Ryle & Hewish)]. Details of the observational method, calibration, data reduction and analysis of the computed results are given.

523.164 **2558**

Observations of some Radio Sources on 3·2 cm.—A. M. Kuzmin, A. D. Kuz'min & A. E. Salomonovich. (*Astron. Zh.*, Jan.–Feb. 1961, Vol. 38, No. 1, pp. 93–96.) A report of observations of discrete r.f. sources Taurus-A, Orion, Cygnus-A and Cassiopeia-A made during June 1960 with a 22-m radio telescope.

523.164: 621.318.57 **2559**

R.F. Switching Circuits and Hybrid Ring Circuits used in Radio Astronomy.—Smith. (See 2485.)

523.164: 621.375.9: 538.569.4 **2560**

An Operational Ruby Maser for Observations at 21 Centimetres with a 60-Foot Radio Telescope.—Jelly & Cooper. (See 2521.)

523.164.32: 523.75 **2561**

On the Relativistic Electrons in the Solar Atmosphere.—K. Sakurai. (*J. Geomag. Geoelect.*, 1961, Vol. 12, No. 2, pp. 70–76.) The ejection of relativistic electrons in association with flares is discussed and the loss of energy of these electrons through synchrotron radiation is related to type-IV r.f. bursts.

523.164.4 **2562**

The Surface Brightness of Radio Sources at Galactic Latitudes Greater than 20°.—P. R. R. Leslie. (*Mon. Not. R. astr. Soc.*, 1961, Vol. 122, No. 1, pp. 51–59.)

523.164.4 **2563**

The Relation between the Optical and Radio Magnitudes of Galaxies.—R. J. Long & D. R. Marks. (*Mon. Not. R. astr. Soc.*, 1961, Vol. 122, No. 1, pp. 61–70.) A statistical relation is found from observations of 200 sources.

523.165 **2564**

A Radio Wave Mechanism to account for the Known Distribution of Van Allen Belts about the Earth.—J. M. Boyer. (*Nature, Lond.*, 13th May 1961, Vol. 190, No. 4776, pp. 597–599.) A mechanism based on a conducting spherical earth illuminated by e.m. and corpuscular radiation from the sun is given to account for the positions of the Van Allen belts. Interference between back-scattered and incident radiation exhibits resonance peaks in a standing-wave pattern, in which peaks solar particles are trapped.

523.165: 550.38 [illegible]

Motion of Low-Energy Solar Cosmic-Ray Particles in the Earth's Magnetic Field.—K. Sakurai. (*J. Geomag. Geoelect.*, 1961, Vol. 12, No. 2, pp. 59–68.)

[illegible] 621.397.332.2 [illegible]

Cosmic Noise Measurements from 0.9 to 3.6 Mc/s.—S. R. Midener, C. A. Franklin & J. P. E. Tyne. (*Nature, Lond.*, 13th May 1961, Vol. 190, No. 4776, pp. 616–617.) Noise field strengths are given, as measured in the satellite, for positions in both hemispheres.

523.82: 621.396.96 [illegible]

A New Determination of the Solar Parallax by means of Radar Echoes from Venus.—J. H. Thomson, G. D. Taylor, J. V. B. Pennefly & R. S. Rogers. (*Nature, Lond.*, 6th May 1961, Vol. 190, No. 4775, pp. 509–510.) The value of $8.7802 \pm 0.0007''$ for sin obtained for the solar parallax is compared with values obtained by other methods. See also *ibid.*, 13th May 1961, Vol. 190, No. 4776, p. 592.

523.75: 523.165 2568

The Time Variations of Solar Cosmic Rays during July 1959 at Minneapolis.—J. R. Winckler, P. D. Bhavsar & L. Peterson. (*J. geophys. Res.*, April 1961, Vol. 66, No. 4, pp. 995–1022.) Balloon observations with ion chambers, Geiger counters and scintillation counters of solar cosmic rays accompanying three large solar flares are reported. Correlation with magnetic data is given and proton energy spectra are calculated.

523.75: 523.165 2569

The High-Energy Cosmic-Ray Flare of May 4, 1960: Part 1—High-Altitude Ionization and Counter Measurements.—J. R. Winckler, A. J. Masley & T. C. May. (*J. geophys. Res.*, April 1961, Vol. 66, No. 4, pp. 1023–1027.) Measurements of cosmic rays from a solar flare are reported. Various types of counters were used in a balloon. The rate at which the particle flux decreased with time is compared with neutron flux measurements at the ground.

523.75: 523.165 2570

The High-Energy Cosmic-Ray Flare of May 4, 1960: Part 2—Emulsion Measurements.—S. Biswas & P. S. Freier. (*J. geophys. Res.*, April 1961, Vol. 66, No. 4, pp. 1029–1033.) Nuclear emulsions recovered from a balloon give the energy spectrum of the cosmic rays. Excess flux was observed of protons in the energy range 200–1 000 MeV. Part 1: 2569 above.

550.385: 539.16 2571

Experimental Analysis of Magnetic and Telluric Effects of the Argus Experiment Recorded at French Stations.—S. Eschenbrenner, L. Ferrieux, R. Godivier, R. Lachaux, H. Larzillière, A. Lebeau, R. Schlich & E. Selzer. (*Ann. Géophys.*, April–June 1960, Vol. 16, No. 2, pp. 264–271.) Recordings made at six stations have been analysed. Results are produced in tabular form and photographic reproductions of typical records are given.

550.385.4 2572

The Steady State of the Magneto-Pressure Problem in Two Dimensions.—J. W. Dungey. (*J. geophys. Res.*, April 1961, Vol. 66, No. 4, pp. 1043–1047.) The form of the cavity in the plane of the dipole and uniform solar stream is derived using the method of complex potentials.

550.385.4: 523.165 2573

Large-Scale Electric Configurations of the Ionosphere at the Sudden Commencement of a Geomagnetic Storm.—J. R. Brown, T. R. Hartz, B. Landmark, H. Leinbach & J. Ortner. (*J. geophys. Res.*, April 1961, Vol. 66, No. 4, pp. 1035–1041.) X-ray bursts coincident in time with two sudden commencement peaks in magnetic records were observed with balloon-borne Geiger counters. Ionospheric absorption data are given. An estimate is made of the electron flux required to account for the X-ray intensities, and their origin is discussed.

550.385.4: 551.510.5 2574

Solar-Terrestrial Dynamics of the Geomagnetic Field and Polar Electrojets.—J. W. Kern. (*J. geophys. Res.*, April 1961, Vol. 66, No. 4, pp. 1289–1292.) The geomagnetic field distortion may introduce longitudinal field gradients which will lead to electrojet-current systems of the form observed.

550.386.37: 550.37 2575

Radiation from a Current Filament above a Homogeneous Earth, with Application to Micropulsations.—P. F. Law & B. M. Fannin. (*J. geophys. Res.*, April 1961, Vol. 66, No. 4, pp. 1049–1059.) Near-field considerations are used to steady the radiations at micropulsation frequencies from an ionospheric current.

550.386.4 2576

The Diurnal Variation of *K* Indices of Geomagnetic Activity on Quiet Days in 1940–1948.—S. B. Nicholson & O. R. Wulf. (*J. geophys. Res.*, April 1961, Vol. 66, No. 4, pp. 1139–1144.) Local-time and universal-time components are derived from the *K* numbers from six observatories in moderately low latitudes.

551.507.362.1 2577

Measurement of the Temperature in the Upper Atmosphere to 150 km in a Rocket Experiment.—J. E. Blamont, T. M. Donahue & M. L. Lory. (*Phys. Rev. Lett.*, 15th April 1961, Vol. 6, No. 8, pp. 403–404.) Spectroscopic observation of sunlight resonantly scattered from a sodium cloud formed by ejection of sodium from a rocket, gave atmospheric temperatures between 100 and 150 km.

551.507.362.1 2578

The Motion of the Third Soviet Cosmic Rocket.—V. T. Gontkovskaya & G. A. Chebotarev. (*Astronom. Zh.*, Jan./Feb. 1961, Vol. 38, No. 1, pp. 125–130.) An investigation of the motion of Lunik III from 15th October 1959 to 30th March 1960. Results are summarized in tabular form.

551.507.362.2 2579

Satellite Orbits about a Planet with Rotational Symmetry.—C. M. Petty & J. V. Breakwell. (*J. Franklin Inst.*, Oct. 1960, Vol. 270, No. 4, pp. 259–282.) An approximate closed-form solution, of high accuracy and without recursion or the inclination angle or eccentricity, is obtained for the equations of motion of an earth satellite.

551.507.362.1 2580

Satellite Orbit Considerations in Venus Fever.—R. R. Allan. (*Nature, Lond.*, 13th May 1961, Vol. 190, No. 4776, p. 615.)

551.507.362.2 2581

The Doppler Effect and Inertial Systems.—K. Tomar. (*Proc. Inst. Radio Engrs*, May 1961, Vol. 49, No. 5, Part 1, p. 975.) The minimum-range equation for the general case of curved orbits of satellite and observer is compared with the equation valid for inertial systems. See 2593 of July.

551.507.362.2 2582

Instrumentation for the First Explorer American Scout Satellite.—A. P. Willmore. (*J. Brit. astronaut. Soc.*, Jan.–Feb. 1961, Vol. 15, No. 1, pp. 11–16. Discussion.) The satellite is primarily designed for studies of the ionosphere. The techniques for measurement of electron density and temperature, ion mass, solar X rays and Lyman-α flux are described.

551.507.362.2: 526.6 2583

Earth Satellites and Geodesy.—I. D. Zhongolovich. (*Astronom. Zh.*, Jan.–Feb. 1961, Vol. 38, No. 1, pp. 115–124.) Examination of possible methods for determining geocentric coordinates of points on the earth's surface from observations of the moon and artificial earth satellites. The determination of the difference between Ephemeris and Universal Time is considered.

551.507.362.2: 526.6 2584

Determination of Position on the Earth from a Single Visual Observation of an Artificial Satellite.—W. A. Scott. (*J. Inst. Nav.*, Jan. 1961, Vol. 14, No. 1, pp. 87–93.) If a reliable orbit is available and an observation of the satellite against a background of stars can be made to an accuracy within 0·1° and timed to 0·2 s, the position of the observer can be determined with sufficient accuracy for navigation purposes. A single visual observation of Echo 1 (1960ι) provides the reference in a worked example.

551.507.362.2: 621.396.722 2585

Ground Equipment for Radio Observations of Artificial Satellites.—Pressey. (See 2777.)

551.507.362.2: 778.53 2586

Design and Results of First Tests on a Camera with a Moving Film for the Photography of Faint Artificial Satellites.—L. A. Panaiotov. (*Astronom. Zh.*, Jan./Feb. 1961, Vol. 38, No. 1, pp. 145–156.)

551.510.53: 621.391.812.63 2587

Air Density Variations in the Mesosphere, and the Winter Anomaly in Ionospheric Absorption.—J. Mawdsley, (*J. geophys. Res.*, April 1961, Vol. 66, No. 4. pp. 1298–1299.) The air density variations observed in winter by Jones et al. (*ibid.*, Dec. 1959, Vol. 64, No. 12, pp. 2331–2340) may indicate air movements which could

cause an enhancement of the NO content and give rise, in turn, to increased ionization and radio wave absorption.

551.510.535 **2588**

Ionization Loss Rates below 90 km.—C. M. Crain. (*J. geophys. Res.*, April 1961, Vol. 66, No. 4, pp. 1117–1126.) A discussion of the loss processes in the D region, with a review of data on the rate coefficients involved. Theoretical height distributions of electrons and of positive and negative ions are given.

551.510.535 **2589**

World Maps of F_2-Layer Critical Frequencies for the Solstice and Equinox Months of 1954 and 1957.—P. Herrinck & J. Goris. (*Ann. Géophys.*, July–Sept. 1960, Vol. 16, No. 3, pp. 358–392.) Hourly world maps of f_0F_2 are analysed as a function of solar activity. Results show (*a*) asymmetrical distribution over the two hemispheres, (*b*) discontinuous diurnal movement of world maximum ionization and (*c*) the existence of four 'poles' in the distribution of the mean diurnal rate of increase of ionization due to solar activity, two of these poles corresponding to the magnetic poles and the other two being located in the equatorial belt where the geomagnetic equator is furthest from the geographic equator. It is concluded that these phenomena cannot be explained by existing theories and that the possibility of corpuscular discharge from a Van Allen belt should be investigated, particularly in relation to equatorial regions.

551.510.535 **2590**

On the Nature of Equatorial Spread-F.—R. Cohen & K. L. Bowles. (*J. geophys. Res.*, April 1961, Vol. 66, No. 4, pp. 1081–1106.) Transequatorial propagation on 50 Mc/s via scattering from the F region above Huancayo was closely associated with equatorial-type (but not temperate-type) spread-F on Huancayo ionograms; i.e. range spreading, not frequency spreading. The irregularities take the form of thin sheets near the bottom of the F layer. They are elongated in the direction of the earth's field, being 1 000 m or more in length, and of the order of 10 m in at least one dimension transverse to the field. It is suggested that equatorial spread-F can occur only when the contours of mean electron density are parallel to the lines of force of the earth's field.

551.510.535 **2591**

Critical Remarks on the Calculation of 'True Heights'.—A. K. Paul. (*Geofis. pura appl.*, Sept.–Dec. 1960, Vol. 47, No. 3, pp. 69–78. In German.) The conditions are given and discussed which permit an unambiguous solution of the integral equation of ionospheric virtual height. Practical procedures and possible sources of error are indicated with some proposals for improved methods of evaluation.

551.510.535 **2592**

The Anomalous Ionospheric Absorption on Winter Days.—M. Bossolasco & A. Elena. (*Geofis. pura appl.*, Sept.–Dec. 1960, Vol. 47, No. 3, pp. 89–100. In English.) The mean diurnal variation is evaluated from ionospheric absorption measurements made at Genoa during 1959–1960. Abnormally high absorption observed in January and February 1959 is discussed with reference to data obtained at other stations; the geographical distribution of the phenomenon and the influence of meteors are considered.

551.510.535: 523.78 **2593**

The Ionosphere at the Garchy Station at the Time of the Eclipse of 2nd October 1959.—A. Haubert. (*Ann. Géophys.*, July–Sept. 1960, Vol. 16, No. 3, pp. 426–427.) Ionization density for true heights ranging from 120 to 260 km is plotted as a function of time for the period 0900–1445 U.T. Results are briefly discussed.

551.510.535: 551.507.362.1 **2594**

Some Results of Direct Probing in the Ionosphere.—W. Pfister, J. C. Ulwick & R. P. Vancour. (*J. geophys. Res.*, April 1961, Vol. 66, No. 4, pp. 1293–1297.) Results of electron density measurements at two frequencies using two different r.f. impedance probe techniques are given. See 1491 of May (Haycock & Baker).

551.510.535: 551.507.362.2 **2595**

Ionospheric Electron Content and its Variations deduced from Satellite Observations.—K. C. Yeh & G. W. Swenson, Jr. (*J. geophys. Res.*, April 1961, Vol. 66, No. 4, pp. 1061–1067.) Faraday fading observations of signals from satellite 1958 δ_2 on 20 and 40 Mc/s have been analysed to show diurnal and seasonal variations of electron content from September 1958 to December 1959. In twelve instances a decrease in content was observed following a magnetic storm.

551.510.535: 551.507.362.2 **2596**

A Local Reduction of F-Region Ionization due to Missile Transit.—H. G. Booker. (*J. geophys. Res.*, April 1961, Vol. 66, No. 4, pp. 1073–1079.) An explanation of an unusual echo received on local ionospheric sounders following the firing of Vanguard II is given in terms of a reduction in the ionization density at the F-layer maximum. The interpretation is extended to explain spread-F and radio-star scintillation.

551.510.535: 621.3.087.4 **2597**

Active High-Frequency Spectrometers for Ionospheric Sounding: Part 2—Selection of the Echo Signals from the Noise Background.—K. Rawer. (*Arch. elekt. Übertragung*, Sept. 1960, Vol. 14, No. 9, pp. 373–379.) The prior knowledge of echo properties such as periodicity, signal shape, r.f. phase and direction of arrival may be used to improve ionospheric recording methods. Part 1: 2209 of July (Bibl).

551.510.535: 621.391.812.63 **2598**

The Relationship of Low-Height Ionosonde Echoes to Auroral-Zone Absorption and V.H.F. D Scatter.—J. K. Olesen & J. W. Wright. (*J. geophys. Res.*, April 1961, Vol. 66, No. 4, pp. 1127–1134.) Weak diffuse echoes are shown at heights between 75 and 95 km in the frequency range 2–8 Mc/s. The diurnal, seasonal and height characteristics of the layer indicate that it is related to auroral-zone absorption and is responsible for v.h.f. forward scatter.

551.510.535: 621.391.812.63 **2599**

Man-Made Heating and Ionization of the Upper Atmosphere.—P. A. Clavier. (*J. appl. Phys.*, April 1961, Vol. 32, No. 4, pp. 570–577.) "Absorption of radio signals by cyclotron resonance is shown to be possible within a very narrow layer of the atmosphere (20 km thick just below 100 km). For a plane-polarized signal only 25% of the power can be absorbed. Better results are obtained (50%) with a circularly polarized radio wave. The absorbable power is limited by the effects obtained, so that an electron density of 3 000 cm^{-3} and an electron temperature of 1 600°K cannot be exceeded. The reason for this is the weakness of the earth's magnetic field."

551.510.535: 621.391.812.63 **2600**
: 551.507.362.2

New Principle of Measurement of Ionospheric Absorption.—É. Vassy. (*C. R. Acad. Sci., Paris*, 20th June 1960, Vol. 250, No. 25, pp. 4189–4190.) The mean coefficient of absorption in the region of the ionosphere below an artificial satellite may be calculated from measurements of the signal strength of the satellite transmission, received on an omnidirectional aerial.

551.510.535(98): 523.745 **2601**

The Arctic Ionosphere and Solar Activity.—N. C. Gerson. (*Ann. Géophys.*, April–June 1960, Vol. 16, No. 2, pp. 253–261.) Ionospheric conditions at several arctic stations have been correlated with solar activity using monthly median critical frequencies for the E, F_1 and F_2 layers and the 13-month mean Zürich sunspot numbers.

551.594.5 **2602**

A Neutral Line Discharge Theory of the Aurora Polaris.—S. I. Akasofu & S. Chapman. (*Phil. Trans. A*, 27th April 1961, Vol. 253, No. 1031, pp. 359–406.)

551.594.5 **2603**

Southernmost Extent of Aurorae according to German Observations on Land and Sea during the International Geophysical Year.—G. Lange-Hesse. (*Naturwissenschaften*, Sept. 1960, Vol. 47, No. 18, pp. 423–424.) Results of observations are interpreted with reference to data from U.S. satellite measurements.

551.594.5: 523.75 **2604**

A Note on 106·1-Mc s Auroral Echoes Detected at Stanford following the Solar Event of November 12, 1960.—R. L. Leadabrand, W. E. Jaye & R. B. Dyce. (*J. geophys. Res.*, April 1961, Vol. 66, No. 4, pp. 1069–1072.) The time of transit of the auroral particles determined from radar observations was 20 h 5 min. A change in range of echoes corresponding to a velocity of 100 km/s was also observed.

551.594.6 **2605**

On the Origin of V.L.F. Noise in the Earth's Exosphere.—T. Ondoh. (*J. Geomag. Geoelect.*, 1961, Vol. 12, No. 2, pp.

77–83.) The primary cause of v.l.f. noise in the exosphere is Čerenkov radiation due to high-speed protons. The natural thermal noise and proton cyclotron radiation effects are considered to be secondary noise sources.

551.594.6 **2606**

Graphical Methods for the Determination of the Distance of Atmospherics from their Waveform.—R. Schminder. (*Geofis. pura appl.*, Sept.–Dec. 1960, Vol. 47, No. 3, pp. 101–113. In German.) Extension of the graphical method outlined in 2222 of July. Delay-time diagrams are given for reflection heights of 70, 80 and 90 km; comparisons are made with tabulated meteorological data.

551.594.6 **2607**

Determination of the Direction of Arrival and the Polarization of Whistling Atmospherics.—J. Delloue. (*J. Phys. Radium*, June & July 1960, Vol. 21, Nos. 6 & 7, pp. 514–526 & 587–599.) Measurements have been made at 5·5 kc/s using two pairs of identical aerials located at the ends of perpendicular base lines. Received signals were passed to a central measuring station via microwave links. Results show that the direction of arrival of the signal makes an angle of between 5° and 25° with the magnetic field. Polarization is consistent with the direction of arrival observed and leads to electron densities about ten times smaller than those given by Storey (142 of 1954).

551.594.6: 539.16 **2608**

Whistlers Excited by Sound Waves.—K. Rawer & K. Suchy. (*Proc. Inst. Radio Engrs*, May 1961, Vol. 49, No. 5, Part 1, pp. 968–969.) Sound waves generated by a nuclear explosion could excite transverse waves in the ionosphere, capable of propagation in whistler modes.

LOCATION AND AIDS TO NAVIGATION

621.396.663: 551.594.5 **2609**

The Ephi System for V.L.F. Direction Finding.—G. Hefley, R. F. Linfield & T. L. Davis. (*J. Res. nat. Bur. Stand.*, Jan.–March 1961, Vol. 65C, No. 1, pp. 43–49.) In the system described the bearing of the transient signal is determined from the relative phase ϕ of the vertical electric field E received at three spaced aerials which are separated by equal-length base lines of $1/3$–$1/10\,\lambda$ at 10 kc/s. Appropriate phase detectors, delay lines and coincidence circuits are used to obtain a directional code in preset sectors. Bearing errors are expected to be $< 1°$.

621.396.932/.933 **2610**

Radio Navigation and Teleguidance at Long Range.—É. Vassy. (*Ann. Télécommun.*, Sept./Oct. 1959, Vol. 14, Nos. 9/10, pp. 256–260.) Phase differences due to ionospheric effects are discussed in relation to the Rana system [3314 of 1953 (Honoré & Torchreux)]. For a given region and time, such a hyperbolic system can theoretically operate correctly at long range provided frequencies are chosen which correspond to plateaus on the relevant $h'(f)$ curves.

621.396.933 **2611**

Doppler in Practice.—(*J. Inst. Nav.*, Jan. 1961, Vol. 14, No. 1, pp. 34–63.) The following papers, which concern intermediate results of evaluation trials of Doppler navigation equipment, were presented at a meeting of the Institute of Navigation on 20th May 1960.

(*a*) Doppler Navigation in S.A.S.—E. S. Pedersen (pp. 34–42).

(*b*) An Evaluation of the Marconi AD 2300.—W. E. Brunt (pp. 42–55).

(*c*) The Potential Application of Doppler to Air Navigation.—J. E. D. Williams (pp. 55–58).

Discussion (pp. 58–63).

621.396.96: 629.13.052 **2612**

The Operation of Radio Altimeters over Snow-Covered Ground or Ice.—W. R. Piggott. (*Proc. Inst. Radio Engrs*, May 1961, Vol. 49, No. 5, Part 1, p. 965.) The reading of a h.f. altimeter above a snow- or ice-covered surface corresponds to the lower boundary of the frozen material and may thus be misleading. See 2346 of July (Piggott & Barclay).

621.396.962.25 **2613**

Analysis of a Frequency-Modulated Continuous-Wave Ranging System.—L. Kay: A. J. Hymans & J. Lait. (*Proc. Instn elect. Engrs*, Part B, March 1961, Vol. 108, No. 38, pp. 238–239.) Discussion of 3523 of 1960.

621.396.963.3: 621.396.677 **2614**

A Fast Electronically Scanned Radar Receiving System.—D. E. N. Davies. (*J. Brit. Instn Radio Engrs*, April 1961, Vol. 21, No. 4, pp. 305–318. Discussion, pp. 319–321.) An experimental method of obtaining the dynamic aerial polar diagram for a 3-cm system with a scanning rate up to 1 Mc/s is described. Absolute limitations of the technique are considered and its application to a 'within-pulse' scanning system is discussed. See 818 of 1959 and back reference.

621.396.963.325 **2615**

The Optimum Exploitation of the Radar P.P.I. Display by a Transmission System with Frequency-Band Compression.—H. Gillmann. (*Frequenz*, Sept. 1960, Vol. 14, No. 9, pp. 306–314.) A theoretical investigation to determine the optimum transmission system for exploiting fully the properties of the display screen, allowing for the influence of the aerial system on azimuthal resolution. Results are given in diagrammatic form.

MATERIALS AND SUBSIDIARY TECHNIQUES

535.215 **2616**

Peculiarities in the Temperature Dependence of the Photoemission of Multi-alkali Cathodes.—G. Frischmuth-Hoffmann, P. Görlich & H. Hora. (*Z. Naturf.*, Nov. 1960, Vol. 15a, No. 11, pp. 1014–1016.) Discussion of results obtained during measurements of quantum yield at low temperatures using cathodes of the type $CsNa_xK_{3-x}Sb$. See also 582 of February (Frischmuth-Hoffmann et al.).

535.215: 546.47'221 **2617**

Electrical and Optical Properties of Zinc Sulphide Crystals in Polarized Light.—J. A. Beun & G. J. Goldsmith. (*Helv. phys. Acta*, 1st Oct. 1960, Vol. 33, Nos. 6/7, pp. 508–513.) Optical transmission, photoconductivity and photovoltaic effect were measured on series of crystals.

535.215: 546.47'48'231 **2618**

Spectral Distribution of the Internal Photo-effect in the ZnSe-CdSe System.—B. T. Kolomiets & Lin' Tszyun'tin. (*Fiz. Tverdogo Tela*, Jan. 1960, Vol. 2, No. 1, pp. 168–170.)

535.215: 546.48'221 **2619**

Enhancement of Photoconductivity upon Cadmium Sulphide Single Crystals.—S. Kitamura, T. Kubo & T. Yamashita. (*J. phys. Soc. Japan*, Feb. 1961, Vol. 16, No. 2, p. 351.) Experimental results on the quenching and enhancement of photoconductivity by infrared radiation, under various conditions of applied voltage, are given. They are not explicable by an existing theory of the effects.

535.215: 546.48'221: 539.23 **2620**

Effect of Heat Treatment upon Sintered Cadmium Sulphide Photoconductive Films.—S. Kitamura. (*J. phys. Soc. Japan*, Sept. 1960, Vol. 15, No. 9, p. 1697.) The relation between dark current and temperature was found to be reversible below and irreversible above 90°C.

535.215: 546.48'231 **2621**

On the Mechanism of the Electrical Conduction in CdSe.—H. Tubota, H. Suzuki & K. Hirakawa. (*J. phys. Soc. Japan*, Sept. 1960, Vol. 15, No. 9, p. 1701.) Experiment showed that the impurity centres contributing to the electrical conduction in CdSe are almost certainly Se vacancies.

535.215: 546.48'231 **2622**

Nonequilibrium Carrier Lifetime in the Surface Layers of (CdSe + Ag) Single Crystals.—U. B. Soltamov & I. G. Perestoronin. (*Fiz. Tverdogo Tela*, Jan. 1960, Vol. 2, No. 1, pp. 26–27.) Activation of the surface by electron bombardment produces a change of the recombination velocity in the surface layer; the nonequilibrium carrier lifetime rises with the amount of activation.

535.215: 546.48'241 **2623**

Investigation of Surface Layers on CdTe Crystals.—Yu. A. Vodakov, G. A. Lomakina, G. P. Naumov & Yu. P. Maslakovets. (*Fiz. Tverdogo Tela*, Jan. 1960, Vol. 2, No. 1, pp. 55–61.)

535.215: 546.48'241 **2624**

Quantum Efficiency of CdTe p-n Junctions in the Ultraviolet Part of the

Spectrum.—G. B. Dubrovskiĭ. (*Fiz. Tverdogo Tela*, April 1960, Vol. 2, No. 4, pp. 569–570.) A note of measurements made of the spectral sensitivity of CdTe photocells of a type described earlier (2815 below) to determine if electron multiplication occurs when the cells are illuminated by short-wavelength light. The excess energy of the primary photocarriers is found to be about 2 eV, i.e., it exceeds the energy gap by about 0·5 eV.

535.215: 546.492'221 **2625**

Certain Features of the Photoconductivity of Mercuric Sulphide.—N. I. Butsko. (*Fiz. Tverdogo Tela*, April 1960, Vol. 2, No. 4, pp. 629–632.) The use and decay characteristics of photoconductivity in hexagonal MgS prepared artificially are similar to those of photoresistors of 'hyperbolic' type such as Se or CdS at low temperatures.

535.215: 546.817'231: 548.5 **2626**

Growth from the Vapour of Large Single Crystals of Lead Selenide of Controlled Composition.—A. C. Prior. (*J. electrochem. Soc.*, Jan. 1961, Vol. 108, No. 1, pp. 82–87.)

535.215: 546.863'231 **2627**

The Mechanism of Photoconductivity in Amorphous Chalcogenide Layers.—B. T. Kolomiets & V. M. Lyubin. (*Fiz. Tverdogo Tela*, Jan. 1960, Vol. 2, No. 1, pp. 52–54.) Results of an investigation of amorphous layers of Sb_2S_3 relating to the dependence of photocurrent on illumination at comparatively high temperature and of the temperature dependence of photocurrent over a wide range of illumination intensities.

535.37: 546.47'221 **2628**

Behaviour of Excited Electrons and Holes in Zinc Sulphide Phosphors.—S. Shionoya, H. P. Kallmann & B. Kramer. (*Phys. Rev.*, 15th March 1961, Vol. 121, No. 6, pp. 1607–1619.) Experimental data are used to correlate the various processes involved in fluorescence, phosphorescence, glow emission, stimulation and quenching. A theoretical discussion of possible transition mechanisms giving rise to these effects is given.

535.376 **2629**

Field Enhancement in ZnSCdS-Mn Phosphors.—G. Wendel. (*Z. Naturf.*, Nov. 1960, Vol. 15a, No. 11, pp. 1010–1011.) Report on luminescence measurements, which suggests that the increase in enhancement ratio observed by Destriau (2753 of 1958) is not primarily due to sensitization by traces of Au.

535.376: 546.47'221 **2630**

The Effects of Infrared Radiation on Trapped Electrons in Excited ZnS Phosphors.—B. Kramer & M. Schön. (*Z. Phys.*, 3rd Oct. 1960, Vol. 160, No. 2, pp. 145–148. In English.) Anomalies in light emission when infrared radiation is applied to ZnS phosphors under ultraviolet excitation are interpreted with reference to experimental results.

537.226: 539.12.04 **2631**

Effect of Pile Irradiation on the Dielectric Properties of Triglycine Sulphate Single Crystals.—E. Fatuzzo. (*Helv. phys. Acta*, 1st Oct. 1960, Vol. 33, Nos. 6/7, pp. 501–504.) Experimental investigation of hysteresis loops deformed as a consequence of neutron bombardment, and of changes in polarization, coercive field and intrinsic bias as a function of integrated neutron flux.

537.227 **2632**

Free Energy of 180° Walls and Surfaces in a Cubic Body-Centred Dipole Lattice.—R. Sommerhalder. (*Helv. phys. Acta*, 1st Oct. 1960, Vol. 33, Nos. 6/7, pp. 617–626. In German.) The free energy of domain walls and of surfaces in ferroelectrics is estimated assuming a simple model of dipole interaction in a body-centred cubic lattice.

537.227 **2633**

Antiferroelectric and Ferroelectric Properties of Certain Solid Solutions containing Pb_2MgWO_6.—N. N. Kraĭnik & A. T. Agranovskaya. (*Fiz. Tverdogo Tela*, Jan. 1960, Vol. 2, No. 1, pp. 70–72.) An investigation of the permittivity of $PbMg_{0.5}W_{0.5}O_3$-$PbTiO_3$ solid solutions in the range −200 to +300°C and the dependence of the Curie point on composition.

537.227 **2634**

Solid Solutions of Niobates and Tantalates based on $BaTiO_3$.—E. V. Sinyakov & E. A. Stafiichuk. (*Fiz. Tverdogo Tela*, Jan. 1960, Vol. 2, No. 1, pp. 73–79.)

537.227 **2635**

Ferroelectric and Antiferroelectric Properties of $NaNbO_3$-$PbZrO_3$ Solid Solutions.—N. N. Kraĭnik. (*Fiz. Tverdogo Tela*, April 1960, Vol. 2, No. 4, pp. 685–690.)

537.227 **2636**

Order-Disorder Model Theory for the Ferroelectric Effect in the Dihydrogen Phosphates.—M. E. Senko. (*Phys. Rev.*, 15th March 1961, Vol. 121, No. 6, pp. 1599–1604.)

537.227 **2637**

Ferroelectricity in the Potassium Ferrocyanide Group Ferroelectrics Substituted by Deuterium for Hydrogen.—S. Waku, K. Masuno & T. Tanaka. (*J. phys. Soc. Japan*, Sept. 1960, Vol. 15, No. 9, p. 1698.)

537.227: 537.311.3 **2638**

The Nature of the Transitional Conduction Processes in Ferroelectric Materials.—V. M. Gurevich, I. S. Zheludev & I. S. Rez. (*Fiz. Tverdogo Tela*, April 1960, Vol. 2, No. 4, pp. 691–696.) An analysis of the conductivity characteristics of $BaTiO_3$ (see 2639 below) and other ferroelectric crystals.

537.227: 546.431'824-31 **2639**

Transitional Direct-Current Conduction Processes in Ceramic $BaTiO_3$.—V. M. Gurevich & I. S. Rez. (*Fiz. Tverdogo Tela*, April 1960, Vol. 2, No. 4, pp. 673–678.) An experimental investigation of the gradual development of current flow, which is attributed to ferroelectric polarization effects.

537.227: 546.431'824-31 **2640**

Effect of Impurities on Electrical Solid-State Properties of Barium Titanate.—C. F. Pulvari. (*J. Amer. ceram. Soc.*, 1st Aug. 1959, Vol. 42, No. 8, pp. 355–363.) An experimental investigation of the skin and bulk properties of $BaTiO_3$ single crystals with various impurity additions.

537.227: 546.431'824-31 **2641**

Effect of Additives of Limited Solid Solubility on Ferroelectric Properties of Barium Titanate Ceramics.—P. Baxter, N. J. Hellicar & B. Lewis. (*J. Amer. ceram. Soc.*, 1st Oct. 1959, Vol. 42, No. 10, pp. 465–470.) Two classes of additives are considered: (*a*) those giving normal ferroelectric properties with particularly low electrical and mechanical losses and (*b*) those giving increased permittivity at room temperatures.

537.227: 546.431'824-31 **2642**

Dielectric After-Effects in Ceramic Barium Titanates.—G. Bullinger. (*Z. angew. Phys.*, Sept. 1960, Vol. 12, No. 9, pp. 410–423.) The polarization mechanism of polycrystalline $BaTiO_3$ is investigated experimentally with particular regard to the dependence of after-effects on temperature and voltage.

537.227: 546.431'824-31 **2643**

Motion of 180° Domain Walls in $BaTiO_3$ under the Application of a Train of Voltage Pulses.—R. C. Miller & A. Savage. (*J. appl. Phys.*, April 1961, Vol. 32, No. 4, pp. 714–721.) The lateral range of the opposing surface-layer field caused by an element of charge on the interface is of the order of 2 000 Å. The observed phenomena are described in terms of the surface-layer model of Drougard & Landauer (923 of 1960).

537.228: 546.431'824-31 **2644**

Piezoresistance and Piezocapacitance Effects in Barium Strontium Titanate Ceramics.—H. A. Sauer, S. S. Flaschen & D. C. Hoesterey. (*J. Amer. ceram. Soc.*, 1st Aug. 1959, Vol. 42, No. 8, pp. 363–366.) A large change of resistance with stress is reported for a series of ceramic compositions in the system $(Ba,Sr,La)TiO_3$, and positive piezocapacitive effect in these compositions in the absence of La.

537.228.1 **2645**

Approximate Method of Calculating Electromechanical Coupling Factor.—M. Marutake. (*Proc. Inst. Radio Engrs*, May 1961, Vol. 49, No. 5, Part 1, p. 967.)

537.228.1 **2646**

Elastic Constants of Ammonium Dihydrogen Phosphate (ADP) and the Laval Theory of Crystal Elasticity.—H. Jaffe & C. S. Smith. (*Phys. Rev.*, 15th March 1961, Vol. 121, No. 6, pp. 1604–1607.)

537.228.1 **2647**

Investigation of Temperature Dependence of the Electric and Elastic Parameters of Cancrinite.—V. A. Koptsik & L. A. Ermakova. (*Fiz. Tverdogo Tela*, April

1960, Vol. 2, No. 6, pp. 697–700.) Report of measurements of dielectric constant, piezoelectric modulus and coefficient of elasticity of caesirinite, a sodium calcium aluminosilicate, in the temperature range +20 to −140°C.

537.311.33 **2648**

Thermally Stimulated Conductivity in Semiconductors.—I. I. Bolkin, E. I. Rashba & A. P. Tyutikhin. (*Fiz. Tverdogo Tela*, Jan. 1960, Vol. 2, No. 1, pp. 109–117.) A theory of thermally stimulated conductivity based on a general semiconductor model is given. From an analysis of experimental data for various heating rates the depth of local levels can be determined.

537.311.33 **2649**

Absorption of Infrared Radiation by Semiconductors in an Electric Field.—N. V. Fomin. (*Fiz. Tverdogo Tela*, April 1960, Vol. 2, No. 4, pp. 605–607.) An expression is derived for the mean absorption probability as a function of the angle between the space vector of the radiation and the electric field direction.

537.311.33 **2650**

Determination of the Effective Mass of Free Charge Carriers in Semiconductors by Infrared Absorption.—K. J. Planker & E. Kauer. (*Z. angew. Phys.*, Sept. 1960, Vol. 12, No. 9, pp. 425–432.) The discrepancies in the determination of charge-carrier mass on the basis of various theories of infrared absorption are discussed. Experimental investigation on n-type CdTe gave an effective mass of 0·24 × free electron mass. 31 references.

537.311.33 **2651**

Confirmation of Lifetimes by Noise and by Haynes-Shockley Method.—S. Okazaki. (*J. appl. Phys.*, April 1961, Vol. 32, No. 4, pp. 712–713.) Values of minority-carrier lifetime in germanium filaments deduced from noise produced by photo-generation of carriers agree well with the values obtained by the Haynes-Shockley method.

537.311.33 **2652**

Nature of an Ohmic Metal Semiconductor Contact.—G. Diemer. (*Physica*, Nov. 1960, Vol. 26, No. 11, p. 889.) An apparent contradiction of the model suggested in 150 of 1957 (Kröger et al.) is explained.

537.311.33 **2653**

Determination of the Semiconductor Surface Potential under a Metal Contact.—N. J. Harrick. (*J. appl. Phys.*, April 1961, Vol. 32, No. 4, pp. 568–570.) An adaptation of Johnson's method (3884 of 1958) is described in which the excess carrier density is measured by an infrared absorption technique.

537.311.33 **2654**

On the Electrical Conductivity of Polar Semiconductors at High Frequencies.—P. H. Fang. (*Ann. Phys., Lpz.*, 8th Sept. 1960, Vol. 6, Nos. 3/4, pp. 115–119. In English.) The formula for the complex electrical conductivity of polar semiconductors as a function of applied frequency, derived by Stolz (3631 of 1959), is evaluated. A method of representing numerical values of conductivity on an Argand diagram is introduced, and the distribution of relaxation times is discussed.

537.311.33 **2655**

The Problem of Internal Breakdown in Nonpolar Semiconductors.—G. V. Gorshkov. (*Fiz. Tverdogo Tela*, April 1960, Vol. 2, No. 4, pp. 611–619.) Equality of the energy obtained by electrons from the applied field and the energy transferred by the electrons to the lattice may occur at any electron temperature. A breakdown criterion is introduced which allows for ionization and recombination.

537.311.33 **2656**

Minerals as Prototypes for New Semiconductor Compounds.—G. Busch & F. Hulliger. (*Helv. phys. Acta*, 1st Oct. 1960, Vol. 33, Nos. 6/7, pp. 657–666. In German.) Numerous new semiconductors with low melting points and activation energies from 0·1 to 3 eV can be obtained by replacing certain elements in the series of minerals listed.

537.311.33 **2657**

Electrical Properties of Certain Semiconducting Oxide Glasses.—V. A. Ioffe, I. B. Patrina & I. S. Poberovskaya. (*Fiz. Tverdogo Tela*, April 1960, Vol. 2, No. 4, pp. 656–662.) The conductivity, thermoelectric power, dielectric loss and permittivity of glasses in the systems V_2O_5-P_2O_5, V_2O_5-P_2O_5-BaO and WO_3-P_2O_5-K_2O have been investigated.

537.311.33 **2658**

Surface Structures and Properties of Diamond-Structure Semiconductors.—D. Haneman. (*Phys. Rev.*, 15th Feb. 1961, Vol. 121, No. 4, pp. 1093–1100.) Results of low-energy electron-diffraction and secondary-emission measurements on GaSb and InSb are discussed, and a general model for (111) surfaces is proposed.

537.311.33 **2659**

Investigation of the Semiconducting Properties of Selenides and Tellurides of Germanium and Tin.—J. W. Verstrepen. (*C. R. Acad. Sci., Paris*, 26th Sept. 1960, Vol. 251, No. 13, pp. 1273–1274.)

537.311.33: 538.63 **2660**

Magnetoelectric and Thermomagnetoelectric Effects in Semiconductors: Part 2.—L. Godefroy & J. Tavernier. (*J. Phys. Radium*, June 1960, Vol. 21, No. 6, pp. 544–550.) The results of a previous paper (3914 of 1960) are used to calculate the conductivity and thermoelectric power tensors in the general case of a crystal of cubic symmetry. Measurements of the magnetoelectric and thermomagnetoelectric effects are not sufficient to establish the band structure of a cubic crystal.

537.311.33: 538.63 **2661**

Investigation of the Diffusion of Minority Current Carriers in a Magnetic Field.—S. M. Ryvkin, A. A. Grinberg, Yu. L. Ivanov, S. R. Novikov & N. D. Potekhina. (*Fiz. Tverdogo Tela*, April 1960, Vol. 2, No. 4, pp. 575–580.) Theoretical discussion and report of measurements of the distribution of minority-carrier concentration in Ge. See 2792 of 1960.

537.311.33: 539.23 **2662**

Interference Method for Measuring the Thickness of Epitaxially Grown Films.—W. G. Spitzer & M. Tannenbaum. (*J. appl. Phys.*, April 1961, Vol. 32, No. 4, pp. 744–745.) In the case of a lightly doped epitaxial layer grown on a heavily doped substrate, incident infrared radiation is reflected at the surface and at the interface to produce interference fringes.

537.311.33: 546.28 **2663**

Surface Properties of Silicon.—V. G. Litovchenko & O. V. Snitko. (*Fiz. Tverdogo Tela*, April 1960, Vol. 2, No. 4, pp. 591–604.) Report and discussion of measurements of the effect of an external electric field on the conductivity, the surface recombination and the capacitor photo-e.m.f. in Si. Results show a complex system of surface levels, five fast and three slow.

537.311.33: 546.28 **2664**

Surface Electrical Changes caused by the Adsorption of Hydrogen and Oxygen on Silicon.—J. T. Law. (*J. appl. Phys.*, April 1961, Vol. 32, No. 4, pp. 600–609.) Measurements of surface conductance, lifetime of injected carriers, change in contact potential with light and contact potential between the Si sample and a reference electrode were made on surfaces cleaned by ion bombardment and during the adsorption of molecular oxygen and atomic hydrogen.

537.311.33: 546.28 **2665**

The Surface Photovoltaic Effect in Silicon and its Application to the Measurement of Minority-Carrier Lifetimes.—A. Quillie* & P. Gosar. (*J. Phys. Radium*, July 1960, Vol. 21, No. 7, pp. 575–578.) Measurements made by means of a modified form of the capacitive-contact method [e.g. 1173 of 1958 (Johnson)] have been used to determine minority-carrier lifetimes. Results are in good agreement with those obtained by the method of Valdes (741 of 1953).

537.311.33: 546.28 **2666**

Investigation of the Accuracy of the Variational Method in the Problem of Impurity Absorption of Light in Silicon.—V. M. Bulmistrov & V. N. Piskovol. (*Fiz. Tverdogo Tela*, April 1960, Vol. 2, No. 4, pp. 608–610.) The accuracy with which the transition frequency can be calculated is within 4%.

537.311.33: 546.28 **2667**

Heat-Treatment Centres in Silicon.—Y. Matukura. (*J. phys. Soc. Japan*, Feb. 1961, Vol. 16, No. 2, pp. 192–197.)

537.311.33: 546.28 **2668**

n-Trapping Centres in n-Type Silicon.—J. Okada & T. Suzuki. (*J. phys. Soc. Japan*, Sept. 1960, Vol. 15, No. 9, p. 1709.) The n-trapping centres correspond to complexes which contain not only oxygen atoms [see 1926 of 1959 Kaiser et al.)], but also vacancies, interstitials or dislocations.

537.311.33: 546.28 **2669**

The Effect of Heat Treatment on the Electrical Properties of *p*-Type Silicon.—I. D. Kirvalidze & V. F. Zhukov. (*Fiz. Tverdogo Tela*, April 1960, Vol. 2, No. 4, pp. 571–574.) Report of measurements of the resistivity and carrier concentration of different single-crystal samples before and after heat treatment in air at temperatures up to 1 200°C.

537.311.33: 546.28 **2670**

Volume Recombination in *p*-Type Silicon Subjected to Heat Treatment at High Temperatures.—G. N. Galkin. (*Fiz. Tverdogo Tela*, Jan. 1960, Vol. 2, No. 1, pp. 8–14.) Heat treatment above 1 200°C produced a recombination level in the lower half of the forbidden band 0·13 ± 0·01 eV from the valence band. The temperature dependence of the capture cross-sections for electrons and holes was determined.

537.311.33: 546.28: 539.12.04 **2671**

Defects in Irradiated Silicon: Part 1 —Electron Spin Resonance of the Si-*A* Centre.—G. D. Watkins & J. W. Corbett. (*Phys. Rev.*, 15th Feb. 1961, Vol. 121, No. 4, pp. 1001–1014.)

537.311.33: 546.28: 539.12.04 **2672**

Defects in Irradiated Silicon: Part 2 —Infrared Absorption of the Si-*A* Centre.—J. W. Corbett, G. D. Watkins, R. M. Chrenko & R. S. McDonald. (*Phys. Rev.*, 15th Feb. 1961, Vol. 121, No. 4, pp. 1015–1022.) *Part 1:* 2671 above.

537.311.33: 546.28: 539.12.04 **2673**

Annealing of Radiation Damage on Lifetime in Silicon.—K. Matsuura & Y. Inuishi. (*J. phys. Soc. Japan*, Feb. 1961, Vol. 16, No. 2, p. 339.)

537.311.33: 546.289 **2674**

Recombination Noise in Germanium to the Range of Defect Semiconductivity.—G. Lautz & M. Pilkuhn. (*Naturwissenschaften*, Sept. 1960, Vol. 47, No. 17, pp. 398.) Report of noise measurements on *n*- and *p*-type single-crystal Ge with differing impurity content, in the temperature range 5–300°K.

537.311.33: 546.289 **2675**

The Relation between Excess Noise and Surface Trapping in Germanium.—L. S. Sochava & D. N. Mirlin. (*Fiz. Tverdogo Tela*, Jan. 1960, Vol. 2, No. 1, pp. 23–25.) Field-effect frequency characteristics are compared with the excess-noise spectrum for the same specimens to test the validity of the McWhorter model [see 173 of 1957 (Kingston & McWhorter)].

537.311.33: 546.289 **2676**

Determination of the Impurity Concentration on Germanium.—R. M. Vinetskiĭ & E. G. Miselyuk. (*Fiz. Tverdogo Tela*, Jan. 1960, Vol. 2, No. 1, pp. 67–69.) Description of a method based on the effect of impurity scattering on resistivity. The impurity concentration is calculated from the measured values of resistivity at two temperatures, and the values are given for change in the resistivity due to lattice scattering on lowering the temperature from 290 to 100°K in *p*-type and *n*-type Ge.

537.311.33: 546.289 **2677**

The Absorption of Light in Germanium.—M. I. Kornfel'd. (*Fiz. Tverdogo Tela*, Jan. 1960, Vol. 2, No. 1, pp. 179–180.) An empirical expression for the absorption coefficient is given.

537.311.33: 546.289 **2678**

Thermal Conductivity of *p*- and *n*-Type Germanium with Different Carrier Concentrations in the Temperature Range 80–440°K.—E. D. Devyatkova & I. A. Smirnov. (*Fiz. Tverdogo Tela*, April 1960, Vol. 2, No. 4, pp. 561–565.) Continuation of an earlier investigation (1620 of 1959) using a different method of measurement.

537.311.33: 546.289 **2679**

Anisotropy of the Surface Breakdown of Germanium in the Range of Strong Fields.—A. I. Morozov. (*Fiz. Tverdogo Tela*, April 1960, Vol. 2, No. 4, pp. 620–623.) Single current pulses of 10–1 000-μs duration and maximum amplitude 30 A were passed through a point contact on samples of *n*- and *p*-type Ge of resistivity 0·1–40 Ω.cm. Discharges observed along the Ge surface were in the form of a straight band emitting reddish light. The experiment showed that the surface breakdown in Ge is anisotropic, which may be due to the anisotropy of "hot" electrons.

537.311.33: 546.289 **2680**

Effect of a Constant Electrical Field on Germanium Fast Surface States.—V. Margoninski. (*Phys. Rev.*, 1st March 1961, Vol. 121, No. 5, pp. 1282–1285.) To resolve conflicting experimental evidence, careful measurements of surface recombination velocity and surface conductivity were performed before and after application of d.c. fields of about 2×10^5 V/cm. Results confirm the assumption that the energy of the recombination centres is not affected by the field.

537.311.33: 546.289 **2681**

Current Flow across Grain Boundaries in *n*-Type Germanium: Parts 1 & 2.—R. K. Mueller. (*J. appl. Phys.*, April 1961, Vol. 32, No. 4, pp. 635–645.) A theory of current flow is given and confirmed by measurements. The measurements were made on specially grown bicrystals in the temperature range 200–350°K where carrier generation in the space charge region could be neglected in the theoretical treatment.

537.311.33: 546.289: 535.215: 538.639 **2682**

Theory of the Anisotropic Photomagnetic Effect in Germanium.—A. A. Grinberg. (*Fiz. Tverdogo Tela*, Jan. 1960, Vol. 2, No. 1, pp. 153–156.) A mechanism is proposed accounting for the effects observed by Kikoin & Bykovskiĭ (2460 of 1958).

537.311.33: 546.289: 538.632 **2683**

Sign Reversal of Hall Coefficients at Low Temperatures in Heavily Compensated *p*-type Germanium.—H. Yonemitsu, H. Maeda & H. Miyazawa. (*J. phys. Soc. Japan*, Sept. 1960, Vol. 15, No. 9, pp. 1717–1718.) Sign reversal occurred at about 5°K.

537.311.33: 546.289: 539.12.04 **2684**

Mobility of Radiation-Induced Defects in Germanium.—P. Baruch. (*J. appl. Phys.*, April 1961, Vol. 32, No. 4, pp. 653–659.) The high electric field in the space charge region of a reverse-bias Ge p^+-n junction is used to study the motion of defects induced in the structure by 1-MeV electrons or γ rays. Evidence is obtained of the nature of these defects and they are correlated with thermal annealing studies.

537.311.33: 546.289: 548.0 **2685**

Crystal Dislocation and Growth of Etch Pits.—W. Riesler. (*Z. angew. Phys.*, Oct. 1960, Vol. 12, No. 10, pp. 433–442.) Experimental investigations on Ge to determine the effects of various etchants and to interpret the course of etch-pit formation from an examination of their shape.

537.311.33: 546.57'72'241 **2686**

Semiconducting 'Compound' Ag_2Te_y.—J. H. Wernick & R. Wolfe. (*J. appl. Phys.*, April 1961, Vol. 32, No. 4, p. 749.) Ag_2Te_y is shown to contain at least two phases, one of which is Ag_2Te. The ternary phase, ideally $AgTeTe_y$, has not been identified.

537.311.33: 546.571'241 **2687**

Degeneracy in Ag_2Te.—C. Wood, V. Harrap & W. M. Kane. (*Phys. Rev.*, 15th Feb. 1961, Vol. 121, No. 4, pp. 978–982.)

537.311.33: 546.571'241: 539.23 **2688**

Electrical Conduction in Thin Films of Silver Telluride.—W. M. Kane & C. Wood. (*J. electrochem. Soc.*, Jan. 1961, Vol. 108, No. 1, pp. 101–102.)

537.311.33: 546.681'36 **2689**

Electrical Properties of *n*-Type GaSb.—A. J. Strauss. (*Phys. Rev.*, 15th Feb. 1961, Vol. 121, No. 4, pp. 1087–1090.) Certain experimental data are not explained by the two-band model of Sagar (2841 of 1960). Systematic differences between the properties of Te-doped and Te-doped samples are probably associated with impurity conduction of the metallic type.

537.311.33: [546.682'28 + 546.681'19] **2690**

Diffusion in Compound Semiconductors.—B. Goldstein. (*Phys. Rev.*, 1st March 1961, Vol. 121, No. 5, pp. 1305–1311.) Self-diffusion in single-crystal InSb and GaAs has been measured, together with the diffusion of Cd, Zn, S and Se in GaAs; the object was primarily to find the diffusion constants and activation energies and then to determine the specific mechanism of diffusion.

537.311.33: 546.682'86 **2691**

Observations of Electron-Hole Current Pinching in Indium Antimonide.—M. Glicksman & R. A. Powlus. (*Phys. Rev.*, 15th March 1961, Vol. 121, No. 6, pp. 1659–1661.) Observations of the current and voltage as a function of time provide substantial corroboration for the occurrence of pinching suggested earlier [3388 of 1959 (Glicksman & Steele)].

537.311.33: 546.73'28 **2692**

An Investigation of the Semiconducting Properties in the Silicon-Cobalt

System.—E. N. Nikitin. (*Fiz. Tverdogo Tela*, April 1960, Vol. 2, No. 4, pp. 633–636.)

537.311.33: 546.814-31 **2695**

Semiconducting Tin Dioxide.—A. Ya. Kuznetsov. (*Fiz. Tverdogo Tela*, Jan. 1960, Vol. 2, No. 1, pp. 35–42.) Description of methods of preparation and properties of SnO_2 films for heating applications.

537.311.33: 546.817'281: 538.63 **2694**

Oscillatory Magnetoresistance in n-Type PbTe.—Y. Kanai, R. Nii & N. Watanabe. (*J. phys. Soc. Japan*, Sept. 1960, Vol. 15, No. 9, p. 1717.) Oscillatory galvanomagnetic effects were observed in n-type PbTe at 4·2 K in a strong pulsed magnetic field.

537.311.33: 548.5 **2695**

Method of Growing Uniform Single Crystals of Alloyed Semiconductor Materials, Solid Solutions and Intermetallic Compounds of Given Composition Determined by the Composition of the Melt.—S. V. Slobodin & G. I. Shmelev. (*Fiz. Tverdogo Tela*, April 1960, Vol. 2, No. 4, pp. 747–755.) Details are given of a floating-crucible technique different from that described by Leverton (3896 of 1958), in which the melt composition in the outlet of the floating crucible from which the crystal is pulled is that of the melt entering from the outer crucible.

537.311.33: 621.317.3 **2696**

Electrodeless Measurement of Semiconductor Resistivity at Microwave Frequencies.—Jacobs, Brand, Shmoys, Strauss & Benjamin. (See 2706.)

537.311.33: 621.362 **2697**

Semiconducting Materials for Thermoelectric Power Generation.—F. D. Rosi, E. F. Hockings & N. E. Lindenblad. (*RCA Rev.*, March 1961, Vol. 22, No. 1, pp. 82–121.)

537.311.33: 621.391.822 **2698**

Fluctuation Noise in Semiconductor Space-Charge Regions.—L. J. Giacoletto. (*Proc. Inst. Radio Engrs*, May 1961, Vol. 49, No. 5, Part 1, pp. 923–927.) In addition to circuit noise, base noise arises from fluctuations in the ionization state of the impurity atoms. Experimental verification of this noise would provide a new method for evaluating some of the properties of semiconductors.

537.311.33: 621.391.822 **2699**

1/f Noise and Channel in Ge p-n Junction.—K. Komatsubara, Y. Inuishi, H. Edagawa & T. Shibaike. (*J. phys. Soc. Japan*, Sept. 1960, Vol. 15, No. 9, pp. 1713–1714.) Direct evidence is given that the inversion-layer channel formation is a predominant source of 1/*f* noise in reverse-biased *p–n* junctions.

537.311.35 **2700**

Electrokinetic Effects in Liquid Semiconductors.—V. B. Fiks & G. E. Pikus. (*Fiz. Tverdogo Tela*, Jan. 1960, Vol. 2, No. 1, pp. 65–66.) The application of an electric field to a liquid semiconductor filling a capillary is considered. By measuring the electrokinetic effects the potential difference between the semiconductor surface and bulk can be determined.

537.323 **2701**

Effects of Doping Additions on the Thermoelectric Properties of the Intrinsic Semiconductor $Bi_2Te_{3-x}Se_x$.—L. G. Bennett & J. R. Wiese. (*J. appl. Phys.*, April 1961, Vol. 32, No. 4, pp. 562–564.)

537.323 **2702**

Effect of Freezing Conditions on the Thermoelectric Properties of Bi_2Te_3 Crystals.—G. J. Cosgrove, J. P. McHugh & W. A. Tiller. (*J. appl. Phys.*, April 1961, Vol. 32, No. 4, pp. 623–625.)

537.323.8 **2703**

Flux Structure of Secondary Emission as Angle of Incidence of the Primary Beam on Titanium Single Crystals.—R. W. Stoffels & A. J. Dekker. (*Phys. Rev.*, 1st March 1961, Vol. 121, No. 5, pp. 1362–1369.)

538.221 **2704**

Magnetic Viscosity due to Solute Atom Pairs: Part 2—Experimental Results.—G. Bozzi, A. Ferro & G. Montalenti. (*J. appl. Phys.*, April 1961, Vol. 32, No. 4, pp. 630–635.) The results confirm the theory given in Part 1 (1250 of April).

538.221 **2705**

Domain Configurations about Nonmagnetic Particles in Iron.—W. D. Yen & R. L. Huggins. (*Phys. Rev.*, 15th Feb. 1961, Vol. 121, No. 4, pp. 1038–1041.)

538.221 **2706**

Small-Angle Grain Boundaries as Obstacles to the Movement of Bloch Walls in Silicon Iron.—W. Stephan. (*Z. angew. Phys.*, Sept. 1960, Vol. 12, No. 9, pp. 398–400.)

538.221: 537.311.31 **2707**

The Influence of Aging Treatment on the Temperature Dependence of the Electric Resistance in Alnico 5 Magnet.—T. Fujiwara & T. Kato. (*J. phys. Soc. Japan*, Sept. 1960, Vol. 15, No. 9, p. 1705.)

538.221: 539.23 **2708**

Direct Measurement of the Uniaxial Magnetic Anisotropy of Vapour-Deposited Thin Films of Iron, Nickel, Permalloy and Cobalt.—Z. Málek & W. Schüppel. (*Ann. Phys., Lpz.*, 28th Sept. 1960, Vol. 6, Nos. 5/6, pp. 252–261.) See also 267 of January (Málek et al.).

538.221: 539.23 **2709**

Spin-Wave Resonance in Ni Films.—H. Nosé. (*J. phys. Soc. Japan*, Sept. 1960, Vol. 15, No. 9, pp. 1714–1715.)

538.221: 539.23 **2710**

Magnetization-Reversal Processes in Thin Ferromagnetic Ni-Fe Films.—S. Middelhoek. (*Helv. phys. Acta*, 1st Oct. 1960, Vol. 33, Nos. 6/7, pp. 519–524. In German.) A study of hysteresis loops in directions parallel and perpendicular to the applied magnetic field, to determine the remanence characteristics.

538.221: 539.23 **2711**

Ni-Fe Single-Crystal Films and their Magnetic Characteristics.—R. R. Verderber & R. M. Kostyk. (*J. appl. Phys.*, April 1961, Vol. 32, No. 4, pp. 696–699.)

538.221: 539.23 **2712**

Free and Forced Oscillations of the Magnetization in Thin Permalloy Films.—P. Wolf. (*Z. Phys.*, 20th Oct. 1960, Vol. 160, No. 3, pp. 310–318.) Free oscillations in the range 300–1 100 Mc/s have been excited in films of thickness 1 000–3 000 Å. Comparisons are made with the characteristics of forced oscillations observed in ferromagnetic resonance experiments. Results show reasonable agreement with theoretical results based on the Landau-Lifshitz equation. See also 3591 of 1960 (Dietrich et al.).

538.221: 539.23 **2713**

Magnetoresistance Effect in the Magnetization Reversal of Permalloy Films.—E. Tatsumoto, K. Kawahara & M. Goto. (*J. phys. Soc. Japan*, Sept. 1960, Vol. 15, No. 9, p. 1703.) Confirmation was obtained that the magnetization reversal in low-frequency fields takes place by domain wall motion and rotation respectively parallel and perpendicular to the easy direction.

538.221: 539.23: 621.385.833 **2714**

Display of Weiss Domains in Thin Ferromagnetic Films by means of an Electromagnetic Electron Microscope.—E. Fuchs. (*Naturwissenschaften*, Sept. 1960, Vol. 47, No. 17, p. 392.) A method is described for using electromagnetic lenses without affecting the magnetic structure of the film, and without having recourse to shadow and schlieren methods.

538.221: 539.234: 538.63 **2715**

The Application of the Magnified Magnetooptical Kerr Effect to Render Visible the Magnetic Domains of Polycrystalline Cobalt and Nickel.—J. Kranz & A. Schauer. (*Naturwissenschaften*, Sept. 1960, Vol. 47, No. 17, pp. 392–393.) Further application of the method used in 1281 of 1959 (Kranz & Drechsel).

538.221: 621.318.134 **2716**

Effects of a Magnetic Field on Heat Conduction in some Ferromagnetic Crystals.—D. Dearnley & S. A. Friedberg. (*Phys. Rev.*, 15th March 1961, Vol. 121, No. 6, pp. 1662–1667.)

538.221: 621.318.134 **2717**

The Measurement of Galvanomagnetic Properties of Ferrites.—K. Zaveta. (*Fiz. Tverdogo Tela*, Jan. 1960, Vol. 2, No. 1, pp. 106–108.) The anomalous temperature dependence of the change of resistance with magnetic field measured near Curie point [3912 of 1958 (Belov & Talalaeva)] can be considered as a magnetothermal effect.

538.221: 621.318.134 **2718**

Experimental Determination of the Components of the Permeability Tensor and the Spectroscopic Splitting Factor of Mg-Mn Ferrites in the Microwave Region: Part 1.—K. H. Gothe. (*Ann. Phys., Lpz.*, 28th Sept. 1960, Vol. 6, Nos. 5/6, pp. 298–306.) An i.f. method was used for

measurement at 3·2 cm λ with the apparatus described. Additional measurements to determine the frequency dependence of the splitting factor were made at 1·25 cm λ.

538.221 : 621.318.134 **2719**

Time Decrease of Magnetic Permeability in some Mixed Ferrites.—K. Ohta. (*J. phys. Soc. Japan*, Feb. 1961, Vol. 16, No. 2, pp. 250–258.) Disaccommodation measurements for a number of ceramic ferrites and also for a single crystal of Ni-Zn ferrite, are described. The displacement of either vacancies or interstitial ions may be the main origin of the phenomenon.

538.221 : 621.318.134 **2720**

Ferromagnetic Alignment by Antiferromagnetic Exchange Interaction. Note on the Magnetic Behaviour of Neodymium Garnet.—W. P. Wolf. (*J. appl. Phys.*, April 1961, Vol. 32, No. 4, pp. 742–743.)

538.221 : 621.318.134 : 537.311.33 **2721**

Electric Conduction of Ferrites containing Fe^{3+} Ions.—N. Miyata. (*J. phys. Soc. Japan*, Feb. 1961, Vol. 16, No. 2, pp. 206–208.) Measurement and interpretation of d.c. conductivities from 100–300°K, for the ferrite solid solution $(MFe_2O_4)_{1-y}(Fe_3O_4)_y$, where M = Mn, Ni, Mn-Ni, or Zn.

538.221 : 621.318.134 : 538.569.4 **2722**

Subsidiary Absorption above Ferrimagnetic Resonance.—P. C. Fletcher & N. Silence. (*J. appl. Phys.*, April 1961, Vol. 32, No. 4, pp. 706–711.) Theory is developed and confirmed by experiment showing that subsidiary absorption can be observed above Kittel resonance. This verifies Suhl's theory of high-power phenomena in ferrites. The absorption occurs at many unsuspected field strengths and is controlled to a certain extent by sample shape and material.

538.221 : 621.318.134 : 538.569.4 **2723**

Measurement of Saturation Magnetization of Ferrites by means of Ferromagnetic Resonance.—F. Schneider. (*Z. angew. Phys.*, Oct. 1960, Vol. 12, No. 10, pp. 447–450.) The saturation magnetization of three polycrystalline ferrites is calculated from the line spacing of the absorption spectrum. Good agreement with values measured by magnetic balance is obtained.

538.221 : 621.318.134 : 538.569.4 **2724**

Temperature Dependence of the Line Width of Ferrimagnetic Resonance in Polycrystalline Nickel-Cadmium Ferrite.—S. Takemoto. (*J. phys. Soc. Japan*, Feb. 1961, Vol. 16, No. 2, p. 344.)

538.221 : 621.318.134 : 548.5 **2725**

Voluntary and Forced Growth Orientation in the Growing of Ferrite Single Crystals.—U. Rösler & G. Elbinger. (*Ann. Phys., Lpz.*, 28th Sept. 1960, Vol. 6, Nos. 5/6, pp. 236–240.)

538.222 : 538.569.4 **2726**

Paramagnetic Relaxation Rates Determined by Pulsed Double Resonance Experiments.—B. Bölger & B. J. Robinson. (*Physica*, Feb. 1960, Vol. 26, No. 2, pp. 133–141.) Results of experiments on synthetic ruby and $K_3Cr(CN)_6/K_3Co(CN)_6$ indicate that the Cr concentration in these salts can be increased to give maser action at higher temperatures.

538.222 : 538.569.4 : 621.375.9 **2727**

Cross-Relaxation and Concentration Effects in Ruby.—R. W. Roberts, J. H. Burgess & H. D. Tenney. (*Phys. Rev.*, 15th Feb. 1961, Vol. 121, No. 4, pp. 997–1000.) Cross-relaxation can improve maser performance even in the absence of doping. Its effect in ruby maser crystals is treated by the introduction of a cross-relaxation probability in the rate equations.

MATHEMATICS

517.432.1 **2728**

New Substantiation of Heaviside's Operational Calculus: Contribution to the Theory of the Solution of Linear Differential Equations.—G. Wunsch. (*Hochfrequenztech. u. Elektroakust.*, Aug. 1960, Vol. 69, No. 4, pp. 133–139.) An alternative method is proposed which is not based on the Laplace transformation; it is simpler mathematically and more adaptable to the solution of practical electrical engineering problems.

MEASUREMENTS AND TEST GEAR

621.3.087.4 **2729**

An Automatic Check-Out and Recording Network.—R. Mansey. (*Electronic Engng*, May 1961, Vol. 33, No. 399, pp. 284–291.) Description of British equipment, designed for the automatic checking of a missile system, which has proved suitable for any aircraft or similar system where the parameters are predominantly electrical.

621.317.3 : 537.311.33 **2730**

Electrodeless Measurement of Semiconductor Resistivity at Microwave Frequencies.—H. Jacobs, F. A. Brand, J. D. Meindl, M. Benant & R. Benjamin. (*Proc. Inst. Radio Engrs*, May 1961, Vol. 49, No. 5, Part 1, pp. 928–932.) The new method depends on the absorption of microwave power in the semiconductor medium. It gives results which depend on bulk properties of the medium and is less subject to errors arising from surface leakage and crystal imperfections.

621.317.3 : 538.632 **2731**

The Voltage Sensitivity of Hall-E.M.F. Probes.—V. V. Galavanov. (*Fiz. Tverdogo Tela*, Jan. 1960, Vol. 2, No. 1, pp. 62–64.) Ge probes have a sensitivity almost 3·7 times that of InSb under no-load conditions. With an external load InAs and InSb probes have a higher figure of merit than Ge. Below 120°K the sensitivity of a probe of high-purity InSb is 20 000 μV/oersted, 400 times higher than at room temperature.

621.317.3 : 621.374.32 **2732**

Digital Measurements.—P. R. Darrington. (*Wireless World*, June 1961, Vol. 67, No. 6, pp. 313–318.) Counter techniques and display methods for frequency, time and voltage measurements are reviewed.

621.317.3 : 621.391.822 **2733**

Measurement of Noise Power Spectra by Fourier Analysis.—A. Z. Akcasu. (*J. appl. Phys.*, April 1961, Vol. 32, No. 4, pp. 565–568.) The theory of the calculation of the power spectrum by direct Fourier analysis is developed and shown to be comparable with autocorrelation analysis in resolution, accuracy and computer requirements.

621.317.355 : 537.311.33 **2734**

Measurement of the Electrical Conductivity and Dielectric Constant without Contacting Electrodes.—T. Ogawa. (*J. appl. Phys.*, April 1961, Vol. 32, No. 4, pp. 583–592.) The torque exerted on a specimen of semiconducting or dielectric material suspended in a circularly or linearly polarized electric field gives the imaginary and real parts of the dielectric constant respectively. The theory of the method is given together with some experimental results obtained on CdS crystals and powders in the frequency range 25 c/s–2 kc/s.

621.317.7 : 621.373.421 **2735**

A Transistorized Frequency Synthesizer.—G. Husson & B. N. Sherman. (*J. Brit. Instn Radio Engrs*, April 1961, Vol. 21, No. 4, pp. 347–350.) A brief description is given of a light-weight unit providing discrete frequencies in the range 2–32 Mc/s in 1-kc/s steps from a 1-Mc/s frequency standard. Spurious responses are reduced to levels impracticable with conventional filter techniques by using an automatic phase control circuit.

621.317.7 : 621.391.82 **2736**

A Portable Instrument for the Measurement of Radio Interference in the Frequency Range 0·15–3 Mc/s.—H. Albsmeier. (*Elektrotech. Z., Edn B*, 3rd Oct. 1960, Vol. 12, No. 20, pp. 483–486.) The battery-operated instrument described conforms to the German VDE specifications for interference-measurement equipment.

621.317.7.029.63/.64 **2737**

A Coaxial Connector System for Precision R.F. Measuring Instruments and Standards.—D. Woods. (*Proc. Instn elect. Engrs*, Part B, March 1961, Vol. 108, No. 38, pp. 205–213.) The connector system does not introduce uncertainties greater than about 3 parts in 10^4 in the admittance parameter, for frequencies up to 4 Gc/s.

621.317.725 : 621.374.32 **2738**

Digital Voltmeter employs Voltage-to-Time Converter.—R. Barker & M. McMahan. (*Electronics*, 5th May 1961,

Vol. 34, No. 18, pp. 67–69.) An inexpensive instrument using no stepping switches is described, in which clock pulses are gated into a counter in proportion to the amplitude of the input voltage.

621.317.733 **2739**

Transformer-Ratio-Arm Bridges.—J. F. Golding. (*Wireless World*, June 1961, Vol. 67, No. 6, pp. 329–335.) The principle of the three-terminal impedance-measuring facility and various circuit arrangements are described. An assessment of accuracy and a comparison with conventional bridges are made.

621.317.733.029.4 **2740**

An Ultra-Low-Frequency Bridge for Dielectric Measurements.—D. J. Scheiber. (*J. Res. nat. Bur. Stand.*, Jan.–March 1961, Vol. 65C, No. 1, pp. 23–42.) The bridge described is capable of measuring the parallel capacitance and resistance of dielectric specimens in the frequency range 0·008–200 c/s.

621.317.738 **2741**

Highly Stabilized and Sensitive Reactance Meter.—B. Ichijo & T. Arai. (*Rev. sci. Instrum.*, Feb. 1961, Vol. 32, No. 2, pp. 122–130.) The instrument has a range of 10^{-3}–10^{6} pF with a sensitivity of 0·001 pF when measured with an ammeter of 100 μA f.s.d. Possible applications are mentioned.

621.317.742 **2742**

Reflectometers.—D. E. Watt-Carter. (*P.O. elect. Engrs' J.*, April 1961, Vol. 54, Part 1, pp. 37–39.) The principles of directional-coupler and of wattmeter types of reflectometer suitable for inclusion in coaxial feeders from h.f. transmitters are described.

621.317.755: 621.374 **2743**

Distortion of Steep Pulse Edges due to Finite Electron Transit Time between Parallel Deflection Plates.—H. Lotsch. (*Frequenz*, Aug. 1960, Vol. 14, No. 8, pp. 264–268.) Investigations of the c.r.o. distortion of step functions with vertical or sloping fronts in relation to electron transit time. A formula is given for calculating true rise time from the measured value.

OTHER APPLICATIONS OF RADIO AND ELECTRONICS

621-52: 621.387.3 **2744**

Cold-Cathode Tube Circuits for Automation.—R. S. Sidorowicz. (*Electronic Engng*, March–May 1961, Vol. 33, Nos. 397–399, pp. 138–143, 232–237 & 296–302.)

621.362 + 621.56 **2745**

The Influence of the Temperature Dependence of Parameters of the Materials on the Efficiency of Thermoelectric Generators and Refrigerators.—B. Ya. Moizhes. (*Fiz. Tverdogo Tela*, April 1960, Vol. 2, No. 4, pp. 728–737.)

621.362: 537.227 **2746**

Application of Ferroelectricity to Energy Conversion Processes.—W. H. Clingman & R. G. Moore, Jr. (*J. appl. Phys.*, April 1961, Vol. 32, No. 4, pp. 675–681.) Simplified and more general expressions are derived for the energy conversion efficiency of a ferroelectric device converting heat energy to electrical energy. Numerical values are obtained for $BaTiO_3$ which has an efficiency in the range 0·5–1·0%. Future applications are discussed.

621.362: 537.311.33 **2747**

Semiconducting Materials for Thermoelectric Power Generation.—F. D. Rosi, E. F. Hockings & N. E. Lindenblad. (*RCA Rev.*, March 1961, Vol. 22, No. 1, pp. 82–121.)

621.362: 621.387 **2748**

Plasma Synthesis and its Application to Thermionic Power Conversion.—K. G. Hernqvist. (*RCA Rev.*, March 1961, Vol. 22, No. 1, pp. 7–20.) Thermionic energy converters are discussed in which the electron space charge is neutralized by positive ion injection.

621.362: 621.387 **2749**

Direct Conversion of Heat to Electromagnetic Energy.—F. M. Johnson. (*RCA Rev.*, March 1961, Vol. 22, No. 1, pp. 21–28.) "The conversion of heat into electromagnetic energy is achieved by utilizing the intrinsically unstable space-charge properties of a thermionic cesium plasma diode. Experimental studies of this phenomenon are described. A physical model for the observed relaxation oscillations is proposed which is in qualitative agreement with experiments."

621.362.012.8 **2750**

Equivalent Circuits for a Thermoelectric Converter.—E. L. R. Webb. (*Proc. Inst. Radio Engrs*, May 1961, Vol. 49, No. 5, Part 1, pp. 963–964.)

621.375.9: 621.372.44: 621.313.13 **2751**

Parametric Variable-Capacitor Motor.—H. E. Stockman. (*Proc. Inst. Radio Engrs*, May 1961, Vol. 49, No. 5, Part 1, p. 970.) A note on the operation of an experimental electric motor analogous to the variable-inductance devices considered earlier (3232 of 1960).

621.384.621 **2752**

Ion Optics in Long, Multistage Accelerator Tubes.—M. Sonoda, A. Katase, M. Seki & Y. Wakuta. (*J. phys. Soc. Japan*, Sept. 1960, Vol. 15, No. 9, pp. 1680–1684.)

621.387.422: 537.311.33 **2753**

***P-N* Junctions as Solid-State Ionization Chambers.**—E. Baldinger, W. Czaja & A. Z. Farooqi. (*Helv. phys. Acta*, 1st Oct. 1960, Vol. 33, Nos. 6/7, pp. 551–557. In German.) The characteristics of *p-n* junction diodes used for counting α-particles and protons are discussed with reference to experimental results.

621.398: 621.3.087.4 **2754**

An Equipment for Processing Time-Multiplexed Telemetry Data.—D. J. McLauchlan & T. T. Walters. (*J. Brit interplan. Soc.*, Jan./Feb. 1961, Vol. 18, No. 1, pp. 33–38. Discussion, pp. 38–39.) A description of the TIMTAPE equipment. It has a magnetic-tape input and, after analogue processing, produces outputs in the form of film and punched cards.

PROPAGATION OF WAVES

621.371: 621.396.945 **2755**

Propagation of Electromagnetic Pulses in a Homogeneous Conducting Earth.—J. R. Wait. (*Appl. sci. Res.*, 1960, Vol. B8, No. 3, pp. 213–253.) The theory of e.m. propagation in both infinite and semi-infinite conducting media is derived, using Laplace transform theory, for various forms of pulse excitation.

621.391.812 **2756**

The Phase Variation of Very-Low-Frequency Waves Propagated over Long Distances.—B. G. Pressey, G. E. Ashwell & J. Hargreaves. (*Proc. Instn elect. Engrs*, Part B, March 1961, Vol. 108, No. 38, pp. 214–226.) A description and analysis of long-term phase variations between two receivers spaced up to 280 km apart and oriented both transverse to and along the direction of the transmitter, at 17·2 kc/s over a 1 000-km path and 15·5 kc/s over 6 000 km.

621.391.812.63 **2757**

Propagation in a Plasma.—P. A. Clavier. (*J. appl. Phys.*, April 1961, Vol. 32, No. 4, pp. 578–582.) "The boundary conditions for a radio signal incident normally on a layer of plasma are discussed. It is shown that 10 different modes must in general propagate in the layer, instead of the usually assumed six. The 10 modes are obtained when the Langevin form of the force is used in Boltzmann's equation."

621.391.812.63: 550.389.2 **2758**

Radio Propagation Conditions in the International Geophysical Year.—B. Beckmann & A. Ochs. (*Nachrichtentech. Z.*, Sept. 1960, Vol. 13, No. 9, pp. 414–418.) The work during the I.G.Y. of the radio propagation service of the German Federal Post Office is reviewed.

621.391.812.63: 551.507.362 **2759**

Doppler Shifts and Faraday Rotation of Radio Signals in a Time-Varying, Inhomogeneous Ionosphere: Part 2—Two-Signal Case.—J. M. Kelso. (*J. geophys. Res.*, April 1961, Vol. 66, No. 4, pp. 1107–1115.) The work described in Part 1 (1294 of April) is extended to the calculation of frequency shift in a two-frequency Doppler experiment and to the determination of rate of Faraday rotation. The formulae contain parameters which require a knowledge of the ray paths.

621.391.812.63: 551.507.362.2 **2760**

Calculation of the Faraday Effect relative to the Ionosphere.—E. Argence,

E. Harnischmacher, H. A. Hess & K. Rawer. (*Ann. Géophys.*, April–June 1960, Vol. 16, No. 2, pp. 272–275.) Some relations concerning the Faraday effect are established in order to study transmissions from 1958 δ_1 at Breisach, Germany. The effect is also examined for frequencies greater than 100 Mc/s.

RECEPTION

621.391.8 : 538.312 **2761**

On the Reception of Electromagnetic Waves.—H. Bondi. (*Proc. roy. Soc. A*, 11th April 1961, Vol. 261, No. 1304, pp. 1–9.) The energy that can be obtained by a receiver from a wave is calculated, assuming that the receiver has full knowledge of the structure of the incident radiation.

621.391.812.6 : 551.507.362.2 **2762**

V.H.F. Satellite Signals Received at Extra-Optical Distances.—L. J. Anderson. (*Proc. Inst. Radio Engrs*, May 1961, Vol. 49, No. 5, Part 1, pp. 959–960.) Data on the reception of v.h.f. signals from distances up to 1 900 miles beyond the radio horizon.

621.391.822 **2763**

A Method of Measurement of the Probability Density of a Noise Voltage and Experimental Verification of the Tendency towards a Gaussian Law by Selective Filtering.—B. Picinbono. (*C. R. Acad. Sci., Paris*, 20th June 1960, Vol. 250, No. 25, pp. 4123–4125.) Description of an experimental method of determining the probability law of background noise by sampling and analysing the sample with an amplitude selector.

621.391.822.1 **2764**

The High-Frequency Minimum Protection Ratio between Two Transmission Channels Amplitude-Modulated with the Same Program.—W. Freutel & F. von Rautenfeld. (*Rundfunktech. Mitt.*, Oct. 1960, Vol. 4, No. 5, pp. 181–193.) The protection ratios required for various test conditions are determined on the basis of subjective assessments by a group of listeners. See also 3464 of 1959 (Belger & von Rautenfeld). For English version see *E.B.U. Rev.*, Oct. 1960, No. 63A, pp. 197–208.

621.396.62 : 621.396.677 : 538.632 **2765**

Pick-Up Devices for Very-Low-Frequency Reception.—G. J. Monser. (*Electronics*, 14th April 1961, Vol. 34, No. 15, pp. 68–69.) The sensitivities of loop and whip aerials vary by as much as 60 dB over the frequency range 10 c/s–10 kc/s. The advantages of using a Hall device as a receiving element are discussed.

621.396.62.001.4 : 621.391.82 **2766**

Evaluating Radio Receiver Susceptibility to Interference.—B. T. Newman, H. Cahn & R. Keyes. (*Electronics*, 14th April 1961, Vol. 34, No. 15, pp. 70–74.) A method is described for comparing the various receiver characteristics which affect intelligibility with those of an idealized standard receiver.

621.396.62.029.63/.64 : 523.164.32 **2767**

Microwave Swept Receiver uses Zero Intermediate Frequency.—D. W. Casey, II. (*Electronics*, 14th April 1961, Vol. 34, No. 15, pp. 59–63.) A frequency sweep from 2 to 4 Gc/s is achieved every 10 s in synchronism with a c.r. tube sweep using a backward-wave local oscillator. The signal band of the i.f. amplifier extends from zero to 5 Mc/s, giving a 3-dB improvement in noise figure and eliminating image rejection problems.

STATIONS AND COMMUNICATION SYSTEMS

621.39 : 621.372.8 **2768**

Long-Distance Waveguide Transmission.—Hamer. (See 2458.)

621.396.1 **2769**

Radio Supervision.—V. Vincentz. (*Elektrotech. Z., Edn B*, 28th Nov. 1960, Vol. 12, No. 24, pp. 581–583.) International arrangements for supervising the occupation of allocated frequency bands and for eliminating sources of interference to radio services are reviewed. Specially designed receiving equipment for use at monitoring stations is mentioned.

621.396.65 **2770**

Bases for Planning a Telecommunication Network in North-West Spain.—A. Arbones Mariño. (*Rev. Telecomunicación, Madrid*, Dec. 1960, Vol. 16, No. 62, pp. 26–34.) Considerations underlying the planning of a radio-link network for local broadcast and television services in difficult terrain are detailed with reference to a projected system.

621.396.65 **2771**

A Radio-Link System for the Transmission of Five High-Quality Broadcast Channels from 30 c/s to 15 kc/s.—H. Oberlack. (*Telefunken Ztg.*, Sept. 1960, Vol. 33, No. 129, pp. 216–222. English summary, p. 246.) Application, with slight modifications, of the p.p.m. system described in 597 of 1958 and back references.

621.396.65 **2772**

The Determination of Harmonic Distortion Coefficients of Radio Links starting from the Linearity Characteristics.—R. Codebupi. (*Note Recensioni Notizie*, Sept./Oct. 1960, Vol. 9, No. 5, pp. 823–834.) A general method is given for deriving the coefficients of harmonic distortion of the output voltage from a quadripole with nonlinear response characteristic.

621.396.65 : 621.372.55 **2773**

The Use of Echo Equalizers at Carrier Frequencies in Wide-Band Transmission Systems.—H. Gutsche. (*Frequenz*, Sept. 1960, Vol. 14, No. 9, pp. 295–299.) The function and adjustment procedure of echo equalizers for use, e.g., in television cable links, are discussed.

621.396.65 : 621.376.55 **2774**

PPM60—a Transistorized Pulse-Phase-Modulation Equipment for 60 Channels.—H. M. Christiansen & M. Schlachte. (*Nachrichtentech. Z.*, Aug. 1960, Vol. 13, No. 8, pp. 392–399.) The design is partly based on that of 24-channel equipment described in 2166 of 1960 (Christiansen & Senft).

621.396.65.029.63 **2775**

The Standardization of International Microwave Radio-Relay Systems.—W. J. Bray. (*Proc. Instn elect. Engrs*, Part B, March 1961, Vol. 108, No. 38, pp. 180–200.) The reasons for defining the particular characteristics adopted by C.C.I.R. and C.C.I.T.T. for line-of-sight paths are discussed.

621.396.721 : 621.396.932 **2776**

Problems in the Design of a Marine V.H.F. F.M. Radio Telephone.—D. W. Ford & G. Eyre. (*Marconi Rev.*, 1st Quarter 1961, Vol. 24, No. 140, pp. 1–25.) Features in the design of low-cost 50-channel equipment using a simple synthesized drive source are discussed.

621.396.722 : 551.507.362.2 **2777**

Ground Equipment for Radio Observations of Artificial Satellites.—B. G. Pressey. (*J. Brit. interplan. Soc.*, Jan./Feb. 1961, Vol. 18, No. 1, pp. 20–27. Discussion.) Interferometers for directional measurements, equipment for the precise measurement of Doppler frequency shift and methods of recording and analysing telemetry signals from both Russian and American satellites are described.

621.396.74 : 621.395.97 **2778**

The Swiss Program Transmission Network.—R. Ziegler. (*Tech. Mitt. PTT*, 1st Dec. 1960, Vol. 38, No. 12, pp. 406–419. In German and French.) Description of the development, present extent and operation of the Swiss system of broadcast transmission over telephone lines.

621.396.93 **2779**

The Problem of the Reduction of Channel Width for Mobile Radio Services.—A. Eastmann. (*Elektrotech. Z., Edn B*, 28th Nov. 1960, Vol. 12, No. 24, pp. 584–588.) The reduction of frequency excursion in f.m. systems and its effect on receiver sensitivity and range are discussed. In comparison, the use of s.s.b. systems would increase the number of channels available but would introduce other difficulties. A reduction of channel width combined with a reduction of service area may be the answer.

SUBSIDIARY APPARATUS

621.311.69 : 551.507.362.2 **2780**

Power Supply for the Tiros I Meteorological Satellite.—S. H. Winkler, I.

Stein & F. Wiener. (*RCA Rev.*, March 1961, Vol. 22, No. 1, pp. 131–146.)

621.311.69: 621.382.23 **2781**

Low-Impedance Thermoelectric Device powers Tunnel Diodes.—E. L. E. Webb & J. K. Pullin. (*Canad. Electronics Engng*, Feb. 1961, Vol. 5, No. 2, pp. 40–43.) The power supply described consists of several Bi_2Te_3 couples in series, heated by a.c.- or d.c.-driven resistance elements and having an output impedance of 0·02 Ω. Results obtained with tunnel-diode microwave oscillators are briefly discussed.

621.311.69: 621.383.5 **2782**

The Effect of Series Resistance on Photovoltaic Solar Energy Conversion.—J. J. Wysocki. (*RCA Rev.*, March 1961, Vol. 22, No. 1, pp. 57–70.) "The series resistance in a photovoltaic cell is divided into two components: contact and sheet resistance. Each of the components is examined theoretically and experimentally, and qualitative agreement between theory and experiment is shown. It is concluded that contact resistance reduces the conversion efficiency more than sheet resistance."

621.311.69: 621.383.5 **2783**

Considerations of Photoemissive Energy Converters.—W. E. Spicer. (*RCA Rev.*, March 1961, Vol. 22, No. 1, pp. 71–81.) "The efficiency of a solar-energy converter consisting of a [Cs]Na_2KSb emitter and an Ag-O-Cs collector is calculated taking into account the initial velocities of the photoelectrons but ignoring space charge. Efficiencies between 2 and 2·1% are obtained for output voltages between 0·8 and 1·6 V. The efficiency increases as the percentage of blue and ultraviolet radiation in the source is increased. To minimize space-charge effects, the emitter-collector spacing must be of the order of 0·01 cm or less."

621.311.69: 629.19 **2784**

Optimum Capacitor Charging Efficiency for Space Systems.—P. M. Mostov, J. L. Newsinger & D. S. Rigney. (*Proc. Inst. Radio Engrs*, May 1961, Vol. 49, No. 5, Part 1, pp. 941–948.) Several theorems for the 'perfect' time-shaped source voltages which optimize the efficiency of energy transfer from source to load are derived. The practical application of the theorems is discussed.

621.314.58: 527·19 **2785**

Three-Phase Static Inverters power Space-Vehicle Equipment.—R. J. Kearns & J. J. Rolfe. (*Electronics*, 5th May 1961, Vol. 34, No. 18, pp. 70–73.) A 115-V three-phase output at 400 c/s is obtained from a d.c. input of 22–29 V by means of Si controlled rectifiers.

TELEVISION AND PHOTOTELEGRAPHY

621.397: [535.7 + 159.93] **2786**

Physiology and Psychology of Television.—E. Otto. (*Tech. Mitt. RRF, Berlin*, Sept. 1960, Vol. 4, No. 3, pp. 94–100.) Various factors controlling the process of vision and the formation of visual impressions are discussed in relation to television.

621.397.132: 621.317.715 **2787**

Test Instruments for Colour Television.—H. Girling & J. Lindner. (*Nachrichtentech. Z.*, Sept. 1960, Vol. 13, No. 9, pp. 428–431.) The mode of operation, the construction and the application of a vectorscope are described.

621.397.331.222 **2788**

Origin and Possible Methods for Compensation of Retrace Noise in Vidicon Camera Equipment.—H. D. Schneider. (*Elektronische Rundschau*, Sept. 1960, Vol. 14, No. 9, pp. 367–368, 371.) The flyback in the horizontal scan circuit produces noise in vidicon cameras, which may result in errors in the output signal. Causes of the noise are analysed and methods for its elimination are quoted.

621.397.331.24 **2789**

Development of a High-Slope Television Picture Tube.—E. Gundert & H. Lotsch. (*Telefunken Ztg*, Sept. 1960, Vol. 33, No. 129, pp. 223–230. English summary, pp. 246–247.) An experimental tube for use with low modulation voltages is described (see also 1042 of March). The electron beam is controlled by a very fine frame grid at 30 μ from the cathode.

621.397.61.029.6 **2790**

Problems of U.H.F. Television Transmission.—T. M. J. Jankobki. (*J. Telev. Soc.*, Jan.–March 1961, Vol. 9, No. 9, pp. 351–366.) Factors affecting the effective radiated power at u.h.f. are briefly surveyed under the following headings: (*a*) transmitting valves for the power amplifier, (*b*) techniques in r.f. amplifier design, (*c*) aerials and transmission lines, (*d*) combining filters.

621.397.61.029.63 **2791**

Operational Experience with a 10-kW Television Transmitter for Band IV with Klystron Output Stage.—A. Kolarz & A. Schweisthal. (*Rundfunktech. Mitt.*, Oct. 1960, Vol. 4, No. 5, pp. 198–200.) Report on the experience gained with the high-power band-IV transmitter described in 682 of 1960.

621.397.62: 621.314.222 **2792**

Third-Harmonic Tuning of E.H.T. Transformers.—E. M. Cherry. (*Proc. Instn elect. Engrs*, Part B, March 1961, Vol. 108, No. 38, pp. 227–236.) Tuning the leakage inductance of a television receiver line output transformer to the "2·6th harmonic" of the flyback pulse prevents ringing and maximizes the h.v. pulse. A detailed analysis is given.

621.397.712.3 **2793**

Technical Equipment and Facilities of the B.B.C. Television Centre, London.—H. Bishop. (*E.B.U. Rev.*, Oct. 1960, No. 63A, pp. 190–196.)

621.397.74 **2794**

Television Standards Conversion.—(*Wireless World*, June 1961, Vol. 67, No. 6, pp. 290–292.) A method of removing the 10-c/s flicker produced when converting from 50- to 60-c/s field frequency, is described.

621.397.74 **2795**

A Standards Converter for Television Exchanges between Europe and North America.—A. V. Lord. (*E.B.U. Rev.*, Oct. 1960, No. 63A, pp. 209–213.) Converter equipment incorporating a storage-type camera tube, is described which is suitable for use between television standards having 50- and 60-c/s field frequencies. For German version see *Rundfunktech. Mitt.*, Oct. 1960, Vol. 4, No. 5, pp. 201–206.

621.397.74: 621.396.65 **2796**

U.K. Television Links.—W. L. Newman. (*Wireless World*, June 1961, Vol. 67, No. 6, pp. 323–326.) The distribution network of the British Post Office is described.

VALVES AND THERMIONICS

621.38: 621.375.029.64/.65 **2797**

Low-Noise Amplifiers for Centimetre and Shorter Wavelengths.—Wade. (See 2515.)

621.382 **2798**

Operation of Tunnel-Emission Devices.—C. A. Mead. (*J. appl. Phys.*, April 1961, Vol. 32, No. 4, pp. 646–652.) The operation of tunnel emission devices using thin layers of metals and insulators is discussed. Diode and triode devices are described, with their frequency, current-density and transfer-ratio limitations. Experimental results are presented for both types using various materials. See 2180 of 1960.

621.382.22 **2799**

Surface Currents in Inversion Layers on Semiconductors.—E. Groschwitz, E. Hofmeister & R. Ebhardt. (*Arch. elekt. Übertragung*, Sept. 1960, Vol. 14, No. 9, pp. 393–396.) Theoretical and experimental results are given relating to the structure of inversion layers and to physical phenomena causing structural changes. Investigations are carried out on point-contact Ge diodes and cover low direct-voltage conditions. See also 3670 of 1960 (Groschwitz & Ebhardt).

621.382.22: 621.376.23 **2800**

Measurements of Power-Conversion Gain and Noise Ratio of the 1N26 Crystal Rectifiers.—A. Dymanus & A. Bouwknegt. (*Physica*, Feb. 1960, Vol. 26, No. 2, pp. 115–126.)

621.382.23 **2801**

Tunnelling Current in Esaki Diodes.—C. W. Bates, Jr. (*Phys. Rev.*, 15th Feb. 1961, Vol. 121, No. 4, pp. 1070–1071.) The integral giving the net current in a tunnel diode is evaluated. Curves calculated for 200, 300 and 350°K compare favourably with those given by Esaki (1784 of 1958).

621.382.23 **2802**

Impurity-Band Conduction and the Problem of Excess Current in Tunnel Diodes.—T. P. Brody. (*J. appl. Phys.*, April 1961, Vol. 32, No. 4, pp. 746–747.) Tunnel currents calculated on the basis of different impurity-band theories are compared. A number of observations support an impurity-band model which postulates a Fermi level close to the conduction band edge.

621.382.23: 621.317.61 **2803**

Tunnel-Diode Curve Tracer is Stable in Negative-Resistance Region.—J. A. Narud & T. A. Fyfe. (*Electronics*, 5th May 1961, Vol. 34, No. 18, pp. 74–75.) The unit described can trace the characteristics of tunnel diodes having G_d^2/C_d ratios as high as 10^9 mho^2/pF.

621.382.23: 621.372.44 **2804**

R.F.-Induced Negative Resistance in Junction Diodes.—J. C. McDade. (*Proc. Inst. Radio Engrs*, May 1961, Vol. 49, No. 5, Part 1, pp. 957–958.) While the fundamental r.f. power is driving a junction diode used as a harmonic amplifier, a negative-resistance effect is present near zero bias whether the harmonic power is dissipated or not.

621.382.3-71 **2805**

Cooling Transistors with Beryllia Heat Sinks.—K. H. McPhee. (*Electronics*, 5th May 1961, Vol. 34, No. 18, pp. 76–78.) Particular advantages of the ceramic material are high thermal conductivity and low dielectric loss.

621.382.3.012.8 **2806**

Transistor Parameters.—G. de Visme. (*Wireless World*, June 1961, Vol. 67, No. 6, pp. 293–299.) Transistor characteristics are defined and the inter-relation of the different sets of parameters is discussed.

621.382.3.012.8 **2807**

A Valve Analogue Circuit for Representing Transistor Properties in the Low-Frequency Region.—K. H. Franke. (*Elektronik*, Nov. 1960, Vol. 9, No. 11, pp. 330–332.) For proof of the analogy on which the circuit given is based see 1343 of April (Tigler).

621.382.333 **2808**

The Frequency Characteristics of Alloy Transistors.—R. Paul. (*NachrTech.*, Aug. 1960, Vol. 10, No. 8, pp. 340–347.) An equivalent circuit of a *p-n-p* alloy junction transistor is derived on which investigation of the frequency dependence of circuit parameters is based.

621.382.333 **2809**

The Mutual Conductance of H.F. Alloy-Junction and Drift Transistors as a Function of Frequency and Working Point and its Derivation.—W. Minner. (*Arch. elekt. Übertragung*, Sept. 1960, Vol. 14, No. 9, pp. 411–420.) Equations are derived and their validity is confirmed by reference to measured values.

621.382.333.33: 621.318.57 **2810**

Designing Avalanche Switching Circuits.—R. P. Rufer. (*Electronics*, 7th April 1961, Vol. 34, No. 14, pp. 81–87.) Avalanche operation of Si mesa transistors is discussed and a criterion for the selection of suitable transistors is given. Typical circuits and operating conditions are described.

621.383.032.217.2 **2811**

Photoelectric and Optical Properties of Sb-Cs and Sb(Mg)-Cs Films.—M. Wada, T. Takahashi & M. Hagino. (*Sci. Rep. Res. Inst. Tohoku Univ., Ser. B*, 1959, Vol. 11, No. 2, pp. 75–96.) Investigation of a method proposed by Schaetti (1611 of 1956) for reducing the dark current of photomultipliers by the addition of Mg to the Sb-Cs cathode material.

621.383.292 **2812**

Photomultiplier with Sb-Na-K Cathode.—W. Baumgartner & J. Linder. (*Helv. phys. Acta*, 1st Oct. 1960, Vol. 33, Nos. 6/7, pp. 608–611. In German.) Preliminary report on the preparation of Sb-Na-K films and on results obtained with photomultipliers incorporating such cathodes.

621.383.5: 621.311.69 **2813**

Spectral Response of Photovoltaic Cells.—J. J. Loferski & J. J. Wysocki. (*RCA Rev.*, March 1961, Vol. 22, No. 1, pp. 38–56.) A theoretical and experimental investigation of the response of *p-n*-junction photocells.

621.383.5: 621.311.69 **2814**

Large-Area Thin-Film Photovoltaic Cells.—H. I. Moss. (*RCA Rev.*, March 1961, Vol. 22, No. 1, pp. 29–37.) Progress has been made with vacuum deposition of CdS on to heated transparent conducting surfaces. Solar conversion efficiencies of 1% are reported.

621.383.5: 621.311.69 **2815**

A *p-n* Junction Photocell of Cadmium Telluride.—Yu. A. Vodakov, G. A. Lomakina, G. P. Naumov & Yu. P. Maslakovets. (*Fiz. Tverdogo Tela*, Jan. 1960, Vol. 2, No. 1, pp. 3–7.) CdTe photocells have been produced with *I/V* characteristics similar to those of Si. Their efficiency as solar-energy converters is 4%.

621.383.5: 621.311.69 **2816**

Properties of *p-n* Junctions in Cadmium Telluride Photocells.—Yu. A. Vodakov, G. A. Lomakina, G. P. Naumov & Yu. P. Maslakovets. (*Fiz. Tverdogo Tela*, Jan. 1960, Vol. 2, No. 1, pp. 15–22.) The *I/V* characteristics of CdTe photocells are discussed. With an appropriate technique of preparation *p-n* junctions can be produced near the surface which give good efficiency at high and low illumination intensities.

621.385.032.213.23 **2817**

Thermionic Emission of Barium Tungstate.—A. I. Mel'nikov, A. V. Morozov, R. B. Sobolevskaya & A. R. Shul'man. (*Fiz. Tverdogo Tela*, April 1960, Vol. 2, No. 4, pp. 704–708.)

621.385.032.26 **2818**

On the Problem of Magnetic Focusing of a Beam of Electrons Emitted with Thermal Velocities.—J. Vejvodová. (*J. Brit. Instn Radio Engrs*, April 1961, Vol. 21, No. 4, pp. 337–344.) An analysis is made to determine the distribution of the current density in a beam of circular or rectangular cross-section focused by a homogeneous longitudinal magnetic field and simultaneously accelerated by a longitudinal e.s. field. The dependence of the total current passing through the anode aperture on the intensity of the focusing magnetic field is calculated, the source of electrons being located in the magnetic field.

621.385.032.209.1 **2819**

Effect of Planar Magnetic Field on the Electron Beam from a Pierce Gun.—A. S. Gilmour, Jr. (*Proc. Inst. Radio Engrs*, May 1961, Vol. 49, No. 5, Part 1, p. 976.) Graphs show the measured current density distributions across the beam for different transverse filament currents.

621.385.1: 534.29 **2820**

Microphony in Electron Tubes.—S. S. Dagnall, E. G. Moorhead & A. Stocker. (*Philips tech. Rev.*, 14th Jan. 1961, Vol. 22, No. 8, pp. 71–88.)

621.385.15: 621.391.822.33 **2821**

Experimental Investigation of the Amplitude Distribution of Scintillation Noise.—H. Rogendagen & K. H. Simon. (*Z. angew. Phys.*, Sept. 1960, Vol. 12, No. 9, pp. 395–397.) Statistical analysis of l.f. noise in the region of 12–5 c/s produced by a narrow-band filter amplifier with an oxide-cathode thermionic valve in the first stage. Results are compared with those based on theoretical distribution.

621.385.15: 621.391.822.33 **2822**

Secondary-Emission Flicker Noise.—R. C. Schwantes & A. Van der Ziel. (*Physica*, Dec. 1960, Vol. 26, No. 12, pp. 1162–1166.) The method used to study flicker noise in pentodes (2824 below) has been extended to secondary-emission valves. Results confirm that the secondary-emission flicker effect is real.

621.385.3: 621.391.822.33 **2823**

Flicker Noise in Triodes with Positive Grid.—R. C. Schwantes & A. Van der Ziel. (*Physica*, Dec. 1960, Vol. 26, No. 12, pp. 1143–1156.) Results were obtained for the magnitude of flicker noise and its correlation at grid and anode for low and high frequencies.

621.385.5: 621.391.822.33 **2824**

Flicker Noise in Pentodes: Flicker Partition Noise.—R. C. Schwantes & A. Van der Ziel. (*Physica*, Dec. 1960, Vol. 26, No. 12, pp. 1157–1161.) The approach used to study flicker noise in positive-grid triodes (2823 above) is modified for pentodes. The existence of a partition component [see 898 of 1955 (Tomlinson)] is confirmed, which is represented by a noise current generator connected between screen grid and anode.

621.387: 621.362 **2825**

Plasma Synthesis and its Application to Thermionic Power Conversion.—Hernqvist. (See 2748.)

621.387: 621.362 **2826**

Direct Conversion of Heat to Electromagnetic Energy.—Johnson. (See 2749.)

Abstracts and References

COMPILED BY THE RADIO RESEARCH ORGANIZATION OF THE DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH AND PUBLISHED BY ARRANGEMENT WITH THAT DEPARTMENT

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ACOUSTICS AND AUDIO FREQUENCIES

534.112-8: 621.374.5 **2827**

Mode Coupling Occurring in the Propagation of Elastic Pulses in Wires.—A. H. Meitzler. (*J. acoust. Soc. Amer.*, April 1961, Vol. 33, No. 4, pp. 435–445.) Longitudinal and flexural ultrasonic pulses in a stretched wire show considerable distortion because of mode coupling at certain critical frequencies. Phase velocity calculations based on the real roots of the Pochhammer equations can be used to predict these critical frequencies for any isotropic elastic material.

534.2 (204) **2828**

Long-Range Sound Propagation in the Deep Ocean.—F. E. Hale. (*J. acoust. Soc. Amer.*, April 1961, Vol. 33, No. 4, pp. 456–464.) A discussion of information available from laboratory reports and unclassified literature on long-range convergence-zone propagation.

534.231 **2829**

Acoustic Intensity Anomalies introduced by Constant Velocity Gradients.—M. A. Pedersen. (*J. acoust. Soc. Amer.*, April 1961, Vol. 33, No. 4, pp. 465–474.) Spurious caustics can arise in ray-theory calculations of intensity based on constant-gradient layers. The use of curved-line segments preserving continuity of velocity and slope in the profile approximation is considered.

534.232: 537.228.1 **2830**

Transient Performance of a Piezoelectric Transducer.—M. Redwood. (*J. acoust. Soc. Amer.*, April 1961, Vol. 33, No. 4, pp. 527–536.) Electrical and mechanical outputs due to step input signals are discussed and analyses made with reference to the exact transmission-line equivalent circuit of a transducer.

534.232-8 **2831**

Hypersonic Resonance of Quartz at 3 500 Mc/s.—J. L. Stewart & E. S. Stewart. (*J. acoust. Soc. Amer.*, April 1961, Vol. 33, No. 4, p. 538.) Pure thickness-mode oscillations in the range 2 950–3 600 Mc/s were observed in X-cut crystals 0·1 mm thick. The damping effect of a thin layer of water was detected.

534.232.089.6 **2832**

Cylindrical-Wave Reciprocity Parameter.—R. J. Bobber & G. A. Sabin. (*J. acoust. Soc. Amer.*, April 1961, Vol. 33, No. 4, pp. 446–451.) A parameter $J_c = (2/\rho c)(R\lambda)^{\frac{1}{2}}L$ for use in standard reciprocity calibration is derived from network theory and from wave propagation theory and its validity is confirmed by experiment.

534.522.1 **2833**

Diffraction of Light by Very-High-Frequency Ultrasonic Waves.—B. R. Rao & J. S. Murty. (*Proc. phys. Soc.*, 1st May 1961, Vol. 77, No. 497, pp. 958–964.) The investigation was carried out using ultrasonic waves in water in the range 50–230 Mc/s.

534.846 **2834**

The Problem of Acoustic Field Conditions in Recording Studios and their Representation in Rooms used for Reproduction.—L. Keibs. (*Tech. Mitt. BRF, Berlin*, Dec. 1960, Vol. 4, No. 4, pp. 125–129.) Theoretical investigations of the relation between direct and indirect sound at different time intervals in rectangular rooms of volume 10 000 m³ and 100 m³ where sound is recorded, are the basis of considerations of how these conditions can best be reproduced.

534.88: 534.417 **2835**

Comparison Analysis on Four Directional-Receiver Correlators.—M. J. Jacobson & R. J. Talham. (*J. acoust. Soc. Amer.*, April 1961, Vol. 33, No. 4, pp. 518–526.) Four systems are analysed and their signal/noise ratios are computed and compared. An examination is also made of their main lobes for various steering directions.

621.395.61.089.6 **2836**

Reciprocity Calibration of Microphones in a Diffuse Sound Field.—H. G. Diestel. (*J. acoust. Soc. Amer.*, April 1961, Vol. 33, No. 4, pp. 514–518.) The reciprocity parameter for a diffuse sound field follows from that for free space by replacing the distance by the 'diffuse-field distance' of a point source. Hence the diffuse-field voltage response can be derived. See 1397 of May.

AERIALS AND TRANSMISSION LINES

621.315.212: 621.372.2 **2837**

On the Theory of the Coaxial Cable.—P. Poincelot. (*C. R. Acad. Sci., Paris*, 17th Oct. 1960, Vol. 251, No. 16, pp. 1623–1624.) Propagation along a coaxial line is studied in terms of Maxwell's equations, without

introducing transmission-line constants. The method is applicable to all symmetric coaxial structures.

621.315.212:621.372.852.32 **2838**

A Magnetically Variable Coaxial Attenuator with Low Basic Attenuation.—J. Deutsch & M. Offner. (*Frequenz*, Oct. 1960, Vol. 14, No. 10, pp. 344–347.) The type of attenuator considered uses a gyromagnetic material with an applied d.c. magnetic field which is variable. In the range 6–8 Gc/s such an attenuator can provide maximum attenuation >12 dB and a minimum of <0·9 dB.

621.315.212.1:621.397.743 **2839**

Recent Developments in Coaxial Cables for Television Distribution.—J. D. S. Hinchliffe. (*J. Brit. Instn Radio Engrs*, May 1961, Vol. 21, No. 5, pp. 457–462.) Constructional improvements incorporated in newly developed cables are discussed. Details are given of methods of testing, and cable characteristics are compared.

621.372.2:621.373.421 **2840**

Tapered Distributed *RC* Lines for Phase-Shift Oscillators.—W. A. Edson. (*Proc. Inst. Radio Engrs*, June 1961, Vol. 49, No. 6, pp. 1021–1024.) The behaviour of tapered transmission lines of distributed capacitance and inductance is examined, and summarized in the form of a set of normalized curves.

621.372.8.029.65 **2841**

Waveguide Equipment for 2-mm Microwaves: Parts 1 and 2.—C. W. van Es, M. Gevers & F. C. de Ronde. (*Philips tech. Rev.*, 16th Feb. & 14th March 1961, Vol. 22, Nos. 4 & 6, pp. 113–125 & 181–189.)

621.372.821 **2842**

Design Notes for Strip-Transmission-Line Tuners.—G. T. Orefice. (*Electronic Ind.*, March 1961, Vol. 20, No. 3, pp. 104–105.) Equations are given for the design of a shorted-line piston-capacitor tuner. They are applied to the case of a resonator with a frequency range of 500–1 000 Mc/s.

621.372.823:621.372.831.1 **2843**

The Excitation of Higher Modes by the Fundamental at an Off-Set Junction of Two Circular Waveguides.—K. Schnetzler. (*Arch. elekt. Übertragung*, Oct. 1960, Vol. 14, No. 10, pp. 421–424.) The mode conversion occurring at slightly displaced flange couplings is calculated using formulae given by Solymar (1111 of 1960) with some corrections.

621.372.823:621.396.65 **2844**

Circular Waveguide for Wide-Band Radio-Link Systems.—E. Gillitzer & R. Herz. (*Frequenz*, Oct. 1960, Vol. 14, No. 10, pp. 347–357.) The properties and characteristics of circular waveguide are discussed and compared with those of rectangular waveguide, with particular reference to their use as aerial feeders in 4-Gc/s radio-link installations.

621.372.826 **2845**

Two-Wire Millimetre-Wave Surface Transmission.—K. Ishii, J. B. Y. Tsui & J. D. Horgan. (*Proc. Inst. Radio Engrs*, June 1961, Vol. 49, No. 6, p. 1076.) Experimental results are given relating to propagation on a two-wire line at 58 Gc/s. Attenuation was much reduced compared with a single-wire line; the spread of the fields appeared to be much smaller.

621.372.831 **2846**

The Excitation of Higher Modes at Waveguide Junctions.—K. Schnetzler. (*Arch. elekt. Übertragung*, Oct. 1960, Vol. 14, No. 10, pp. 425–431.) Formulae are derived for calculating the spurious modes generated in a gradual transition between different waveguide, including the case in which the spurious mode is propagated only in part of the transition. See also 1726 of June and 2843 above.

621.372.852.1 **2847**

Design Relations for Resonant Post Waveguide Filters.—R. D. Wanselow. (*J. Franklin Inst.*, Feb. 1961, Vol. 271, No. 2, pp. 94–107.) The procedures and graphs given for the design of waveguide filters with *Q*-factors under load ranging from 4 to 200 are shown to be adequate for most engineering applications.

621.372.852.21 **2848**

A Microwave Phase-Shifter with Dielectric Prisms.—R. Tremblay. (*Canad. J. Phys.*, March 1961, Vol. 39, No. 3, pp. 409–418. In French.) Two identical prisms in opposition form a dielectric plate in a rectangular waveguide. The displacement of one relative to the other along the hypotenuse changes the effective length of the plate.

621.372.852.323 **2849**

Resonance Isolators for Millimetre Waves.—H. G. Beljers. (*Philips tech. Rev.*, 4th Nov. 1960, Vol. 22, No. 1, pp. 11–15.) Compact isolators for 35 and 70 Gc/s using crystal-oriented anisotropic ferrites are described.

621.396.67:624.97.042 **2850**

Load Specification for Aerial Supports.—F. Staiger. (*Rundfunktech. Mitt.*, Dec. 1960, Vol. 4, No. 6, pp. 253–257.) The problem in load calculations of allowing for ice formation on aerial masts is considered in order to achieve greater uniformity in design specifications.

621.396.67.095.1 **2851**

Generating a Rotating Polarization.—S. R. Penstone & A. W. Adey. (*Proc. Inst. Radio Engrs*, June 1961, Vol. 49, No. 6, p. 1089.) A method is described of generating an e.m. wave whose plane of polarization rotates at 80 c/s, for use in rocket determinations of the electron density in the ionosphere. See also 2615 of 1960 (Allen).

621.396.677.029.6 **2852**

Investigations on Endfire Aerials in the Microwave Region.—T. Heller. (*Nachrichtentech. Z.*, Nov. 1960, Vol. 13, No. 11, pp. 529–533.) The aerials considered are dielectric-rod radiators of helical-line and Yagi structure, and the zig-zag aerial [2846 of 1959 (Sengupta)]. The Hansen-Woodyard conditions for optimum directivity are determined, and practical measures for improving aerial efficiency are mentioned.

621.396.677.3:621.396.43 :551.507.362.2 **2853**

Communications Satellites using Arrays.—Hanson. (See 3149.)

621.396.677.3:621.397.61 **2854**

Dipole Arrays for Transmitter Aerials for Television Bands IV/V.—H. Laub. (*Frequenz*, Oct. 1960, Vol. 14, No. 10, pp. 327–334.) Problems of electrical and mechanical design of aerial arrays for the frequency range 470–790 Mc/s are discussed; a number of arrays are illustrated and examples of polar diagrams are given.

621.396.677.71 **2855**

Hybrid H-Guide Feeds Flush-Mounted Antennas.—G. N. Voronoff. (*Electronics*, 31st March 1961, Vol. 34, No. 13, pp. 54–57.) A two-dimensional array of slot radiators can be excited in this way.

621.396.677.73 **2856**

Horn Radiators as Gain Standards.—K. E. Müller & J. Göller. (*Nachr Tech.*, Sept. 1960, Vol. 10, No. 9, pp. 414–422.) Approximation formulae for gain and field strength are given and the design procedure is summarized, with a comparison of calculated and measured characteristics.

621.396.677.73:621.396.663 **2857**

Direction-Finding Aerials with High Bearing Accuracy and Wide Frequency Ranges.—K. P. Lensch. (*Z. angew. Phys.*, Dec. 1960, Vol. 12, No. 12, pp. 557–567.) Report of measurements on conical radiators of differing shape and construction, in the frequency range 100–2 400 Mc/s. Measured radiation patterns are compared with those based on calculated values; agreement is only approximate.

621.396.677.85 **2858**

A Microwave Lens for Rapid Scanning.—A. M. Scheggi & G. Toraldo di Francia. (*Alta Frequenza*, Oct. 1960, Vol. 29, No. 5, pp. 438–449.) Description of the design and construction of a configuration lens for 360° scanning, and also of a stack of such lenses. The radiation patterns and wave fronts obtained conform to theoretical predictions.

AUTOMATIC COMPUTERS

681.142 **2859**

The Physics of Computer Elements.—C. N. W. Litting. (*Brit. J. appl. Phys.*, May 1961, Vol. 12, No. 5, pp. 207–213.) The general principles of acoustic, electrostatic, magnetic, optical, and superconducting storage systems are discussed. Magnetic or superconducting devices show the greatest promise for future high-speed applications.

681.142 **2860**

Control-Pulse Generation for a Digital Differential Analyser.—P. L. Owen, M. F. Partridge & T. R. H. Sizer.

(*Electronic Engng*, June 1961, Vol. 33, No. 400, pp. 364–371.) Circuit details are given of a transistorized unit which generates control pulses by a pulse-division method involving some unusual processes.

681.142 : 539.23 **2861**

Thin Films as Elements for Automatic Computers.—W. E. Proebster. (*Elektrotech. Z., Edn A*, 5th Dec. 1960, Vol. 81, No. 25, pp. 913–920.) A review covering the application of thin-film storage devices, including the cryotron, to data-processing techniques. 33 references.

681.142 : 621.382.23 **2862**

High-Speed Logic Circuits using Diode Logical Networks and Current-Switching Amplifiers.—R. J. Miles. (*Mullard tech. Commun.*, March 1961, Vol. 5, No. 47, pp. 286–294.) The use of diode networks as an alternative to transistors in logical networks is considered. The circuits are versatile and economical, but require associated amplifiers and are likely to have a limiting switching time of about 10 ns.

681.142 : 621.382.23 **2863**

Output-Coupling Networks for Use with Logical Circuits of the Emitter-Current Switching Type.—R. J. Miles. (*Mullard tech. Commun.*, March 1961, Vol. 5, No. 47, pp. 295–300.) Zener-diode coupling networks required to transfer the collector-voltage swing in emitter-current switching circuits to earth level are considered. The disadvantage of low coupling efficiency of passive output coupling networks is considered in comparison with the versatility which they give to standard logical elements.

CIRCUITS AND CIRCUIT ELEMENTS

621.3.004.6 **2864**

Reliability of Electronic Components.—(*Nachrichtentech. Z.*, Nov. 1960, Vol. 13, No. 11, pp. 505–528.) Four papers based on contributions to a discussion meeting on circuit components and materials held by the *Nachrichtentechnische Gesellschaft* in Stuttgart, 5th/6th May 1960.

(*a*) Technological Measures for Improving the Reliability of Components.—K. H. J. Rottgardt (pp. 505–512).

(*b*) Lifetime Investigations on Capacitors.—W. Ackmann (pp. 513–518).

(*c*) The Effect of Humidity on the Electrical Characteristics of Capacitors.—H. Veith (pp. 519–523).

(*d*) The Unreliability of Electronic Equipment and its Causes.—H. J. Fründt (pp. 524–528).

621.3.049.7 **2865**

Recent Advances in Microminiaturization, Reliable Components and Cooling Techniques.—G. W. A. Dummer. (*Solid-State Electronics*, Jan. 1961, Vol. 2, No. 1, pp. 18–34.)

621.3.049.75 : 621.382 **2866**

Silicon Epitaxial Microcircuit.—W. Glendinning, C. Marlett, J. Allegretti & D. Shombert. (*Proc. Inst. Radio Engrs*, June 1961, Vol. 49, No. 6, pp. 1087–1088.) A Si microcircuit formed by vapour-phase deposition techniques is described. An eight-layered epitaxial structure was formed which was capable of oscillation in different modes. Shunting capacitive and resistive leakage effects are discussed.

621.314.224.029.4 **2867**

The Design and Performance of High-Precision Audio-Frequency Current Transformers.—J. J. Hill & A. P. Miller. (*Proc. Instn elect. Engrs*, Part B, May 1961, Vol. 108, No. 39, pp. 327–332. Discussion, pp. 337–338.) Conventional multilayer current transformers are found to have large high-frequency errors. Details are given of precision single-layer transformers which cover the range 50 c/s–30 kc/s.

621.316.5 **2868**

Application of Boolean Notation to the Maintenance of Switching Circuits.—S. Alexander. (*Electronic Engng*, June 1961, Vol. 33, No. 400, pp. 372–374.) Concise notation by Boolean algebra of the operations in the maintenance schedules of complex switching circuits is used to simplify testing and fault location.

621.318.132 **2869**

High-Stability Ferrite Pot Cores.—W. A. Everden. (*J. Brit. Instn Radio Engrs*, May 1961, Vol. 21, No. 5, pp. 409–414.) Describes a range of assemblies suitable for laboratory use and for bulk production of stable inductors.

621.318.57 : 538.221 : 621.318.134 **2870**

Analysis of Ferrite-Core Switching for Practical Applications.—P. A. Neeteson. (*Electronic Applic.*, Feb. 1961, Vol. 20, No. 4, pp. 133–152.) An analytical expression describing the switching process is derived which is suitable for practical circuit design. Measurements confirm the results of calculations.

621.318.57 : 621.375.3 **2871**

Core Matrix Driver employing Magnetic Amplifiers.—J. Yamato & Y. Suzuki. (*Rev. elect. Commun. Lab., Japan*, Jan./Feb. 1961, Vol. 9, Nos. 1/2, pp. 43–49.) A high-frequency magnetic amplifier with high efficiency, good signal/noise ratio and high output power has been developed.

621.319.4 : 621.372.54 **2872**

Low-Impedance Capacitor Design with Special Application to Filters.—C. W. McCutchen & I. D. Howard. (*Electronic Engng*, June 1961, Vol. 33, No. 400, pp. 349–353.) Methods of reducing series inductance of conventional capacitors are investigated. Measurements of capacitor characteristics are discussed and an improved method of connection for filter capacitors is described.

621.372.44 **2873**

The Reactive Behaviour of Non-linear Negative Differential Resistors.—V. Cimagalli. (*Alta Frequenza*, Oct. 1960, Vol. 29, No. 5, pp. 548–554.) Nonlinear negative-resistance two-poles may have a reactive component when forming part of a given relaxation oscillator circuit.

621.372.44 **2874**

A General Steady-State Analysis of Power/Frequency Relations in Time-Varying Reactances.—R. G. Smart. (*Proc. Inst. Radio Engrs*, June 1961, Vol. 49, No. 6, pp. 1051–1058.) This analysis produces the Manley-Rowe results as special cases. An 'energy coefficient' is derived which specifies the behaviour of an individual frequency transformation. The modes in which an individual transformation can operate are described and related to a wide range of varying-reactance devices.

621.372.5 : 621.382.3 : 517.945 **2875**

The Calculus of Deviations applied to Transistor Circuit and Network Analysis.—T. R. Nisbet & W. W. Happ. (*J. Brit. Instn Radio Engrs*, May 1961, Vol. 21, No. 5, pp. 437–450.) Network analysis is simplified by the method described; rules are given for solving various transistor problems including the distributed-parameter network.

621.372.54 **2876**

Some Considerations on Optimum Filters.—F. Pandarese. (*Note Recensioni Notiz.*, Nov./Dec. 1960, Vol. 9, No. 6, pp. 1043–1051.) An explicit formula is derived which gives the pulse response of a filter for signal detection in noise, where the known signal is expressed in the form of a trigonometric polynomial.

621.372.54 **2877**

The Design of All-Pass, Low-Pass and Band-Pass Filters with a Tchebycheff-Type Approximation of Constant Group Delay.—E. Ulbrich & H. Piloty. (*Arch. elekt. Übertragung*, Oct. 1960, Vol. 14, No. 10, pp. 451–467.)

621.372.54 **2878**

Replacement of a Cascade of *n* Unequal Asymmetric Quadripoles of Equal Iterative Impedance by One Quadripole.—W. Herzog. (*Nachrichtentech. Z.*, Oct. 1960, Vol. 13, No. 10, pp. 475–477.)

621.372.54 **2879**

The Cascade Connection of Non-reversible Quadripoles.—W. Herzog. (*Nachrichtentech. Z.*, Oct. 1960, Vol. 13, No. 10, pp. 477–478.)

621.372.54 : 621.372.57 **2880**

The Synthesis of Active and Passive Filters by the Root Locus Method.—A. Susini. (*Alta Frequenza*, Oct. 1960, Vol. 29, No. 5, pp. 555–573.)

621.372.54 : 621.375.4 **2881**

Active Filter Element and its Application to a Fourier Comb.—F. T. May & R. A. Dandl. (*Rev. sci. Instrum.*, April 1961, Vol. 32, No. 4, pp. 387–391.) A theoretical analysis is given and constructional data are presented for a variable-*Q* variable-frequency band-pass filter using transistor amplifiers. Stable-*Q* operation is possible over a *Q*-factor range of 10–250 for frequencies up to 4 kc/s.

621.372.57 : 621.317.361.018.756 **2882**

The Applicability of Active Filters to the Measurements of the Frequency Spectra of Pulses.—H. G. Jungmeister. (*Arch. elekt. Übertragung*, Oct. 1960, Vol. 14, No. 10, pp. 432–434.) The use in frequency analysers of active filters comprising amplifiers with double-T type *RC* networks, results in higher *Q*-values at low frequencies than is possible with stagger-tuned *LC* circuits. The error assessment given by Seeger & Stäblein (1497 of 1958) is also applicable to this type of circuit.

621.372.6 **2883**

Synthesis of Transformerless Active n-Port Networks.—I. W. Sandberg. (*Bell Syst. tech. J.*, May 1961, Vol. 40, No. 3, pp. 761–783.)

621.373.431.1 : 621.382.23 **2884**

A Circuit with Several Stable States using Tunnel Diodes.—Y. Hazoni. (*Nuclear Instrum. Meth.*, March 1961, Vol. 10, No. 3, pp. 229–230. In French.) The circuit has four stable states, the time required for a change of state being of the order of 10^{-8}s. It can serve as a fast pre-storage device for a multichannel analyser or as the basic unit of an associated address scaler.

621.374 : 621.382.23 **2885**

A Tunnel-Diode Univibrator and Pulse Height Discriminator.—Y. Hazoni. (*Nuclear Instrum. Meth.*, March 1961, Vol. 10, No. 3, pp. 231–233.) An adaptation of the tunnel-diode oscillator circuit (2884 above) and its operation in conjunction with a biased backward diode [see *Wescon Convention Record Inst. Radio Engrs*, 1959, Vol. 3, Part 3, pp. 9–31 (Lesk et al.)] are described. Applications in pulse shaping and fast coincidence technique are noted.

621.374.3 **2886**

A Fast Amplitude Discriminator.—A. Sarazin, J. Samueli & G. Bougnot. (*Nuclear Instrum. Meth.*, March 1961, Vol. 10, No. 3, pp. 202–204. In French.) The circuit has a discrimination range of 1–30 V, with a threshold stability within ± 0·1 V. The output is a positive pulse 1·5 V in amplitude, with rise time <10 ns and duration 200 ns.

621.374.3 : 621.382.3 **2887**

New Ways to Trigger Avalanche Pulse Circuits.—H. G. Dill. (*Proc. Inst. Radio Engrs*, June 1961, Vol. 49, No. 6, p. 1093.)

621.374.32 **2888**

Reversible Decimal Counters.—J. L. Goldberg. (*Electronic Technol.*, July 1961, Vol. 38, No. 7, pp. 234–245.) Circuit design for both binary and bi-quinary scales of notation is discussed.

621.374.32 : 621.382.23 **2889**

Tunnel-Diode Binary Counter Circuit.—H. Ur. (*Proc. Inst. Radio Engrs*, June 1961, Vol. 49, No. 6, pp. 1092–1093.)

621.375.127 **2890**

Investigation of the Single-Ended Push-Pull Amplifier.—F. Cervellati & P. Schiaffino. (*Alta Frequenza*, Oct. 1960, Vol. 29, No. 5, pp. 512–547.) Theoretical and practical design aspects of various versions of this type of a.f. amplifier are considered.

621.375.4 **2891**

A Quick Method for Calculating Transistor Amplifier Circuits.—R. R. Vierhout & A. J. H. Vendrik. (*Electronic Engng.*, June 1961, Vol. 33, No. 400, pp. 375–381.) By neglecting the parameter h_{12} calculations on transistor amplifiers can be greatly simplified. This is applied in calculations of feedback, temperature stability and noise.

621.375.4 : 621.372.632 **2892**

Calculation of Mixing Processes in Transistor Stages at Low Frequencies on the Basis of the Equivalent Circuit Diagram.—J. S. Vogel & M. J. O. Strutt. (*Arch. elekt. Übertragung*, Oct. 1960, Vol. 14, No. 10, pp. 435–440.) Extension of the theory given in 2516 of August to transistor mixer circuits and to distortion effects in them.

621.375.4.018.783 **2893**

Nonlinear Distortion of Transistorized Amplifiers.—H. H. van Abbe & G. C. van Slagmaat. (*Electronic Appl.*, Feb. 1961, Vol. 20, No. 4, pp. 159–168.) Sources of distortion are examined and methods are suggested for minimizing their effects.

621.375.432 **2894**

Designing Amplifiers with Nonlinear Feedback.—J. C. Looney. (*Electronics*, 31st March 1961, Vol. 34, No. 13, pp. 46–49.) Design criteria for the use of a nonlinear feedback loop with a transistor amplifier are given. Increase of dynamic range and an exponential response can be obtained.

621.375.9 **2895**

Design Theory of Optimum Negative-Resistance Amplifiers.—E. S. Kuh & J. D. Patterson. (*Proc. Inst. Radio Engrs*, June 1961, Vol. 49, No. 6, pp. 1043–1050.) An examination is made of amplifiers obtained by imbedding a linear active one-port device in arbitrary three-port devices. The optimum gain-bandwidth formula, synthesis procedure and design curves are given for this and other amplifier configurations.

621.375.9 : 538.569.4 **2896**

Amplification through Stimulated Emission—the Maser.—R. A. Smith. (*Brit. J. appl. Phys.*, May 1961, Vol. 12, No. 5, pp. 197–206.) An account of the physical principles underlying two- and three-level maser action is given and expressions for noise factor are derived. Recent maser applications in radio astronomy systems are noted.

621.375.9 : 538.569.4 **2897**

General Analysis of Optical, Infrared, and Microwave Maser Oscillator Emission.—J. R. Singer & S. Wang. (*Phys. Rev. Lett.*, 1st April 1961, Vol. 6, No. 7, pp. 351–354.) The equations governing coherent emission are generalized. Amplitude modulation of the signal is to be expected and this can be used for communication purposes.

621.375.9 : 538.569.4 : 538.222 **2898**

Cross-Doping Agents for Rutile Masers.—P. F. Chester. (*J. appl. Phys.*, May 1961, Vol. 32, No. 5, pp. 866–868.) The electron paramagnetic resonance spectra of rutile doped with Ta, Nb and Ce have been examined at liquid-helium temperatures. Ta and Nb appear to be suitable for securing a short spin-lattice relaxation time.

621.375.9 : 621.372.2 **2899**

A New Microwave Power Amplifier.—P. A. Clavier. (*Proc. Inst. Radio Engrs*, June 1961, Vol. 49, No. 6, pp. 1083–1084.) A method is suggested in which one electrode of a Lecher or coaxial line is made electron-emissive. A signal propagated down the line produces an amplified current in the anode.

621.375.9 : 621.372.44 **2900**

Nonreciprocal Parametric Amplifier Circuits.—L. D. Baldwin. (*Proc. Inst. Radio Engrs*, June 1961, Vol. 49, No. 6, p. 1075.) Two circuit configurations are given which do not use a circulator but which have similar properties to the single-port reflection amplifier with a three-port circulator.

621.375.9 : 621.372.44 **2901**

Staggered Operation of Doubly Resonant Parametric Amplifiers.—S. Hamada & H. Mukai. (*Rev. elect. Commun. Lab., Japan*, Jan./Feb. 1961, Vol. 9, Nos. 1/2, pp. 20–25.) A broad bandwidth is achieved by staggered operation of doubly resonant variable-capacitance parametric amplifiers in the 6-Gc/s band.

621.375.9 : 621.372.44 : 621.318.435 **2902**

On Parametric Excitation with Current-Saturable Inductances.—N. S. Prywes. (*J. Franklin Inst.*, Dec. 1960, Vol. 270, No. 6, pp. 468–491.) A parametric-amplifier circuit with an abrupt nonlinearity is described. A method of analysis of 'relaxation oscillations' leads to a physical understanding of the cycle of oscillations and quantitative relations. The stability problem is also solved.

621.375.9 : 621.372.44 : 621.382.23 **2903**

Minimum Noise Figure of the Variable-Capacitance Amplifier.—K. Kurokawa & M. Uenohara. (*Bell Syst. tech. J.*, May 1961, Vol. 40, No. 3, pp. 695–722.) A discussion of the minimum noise figure of variable-capacitance diode amplifiers, on the assumption that the series resistance is the only parasitic element. Some experimental figures are given for d.s.b. operation at 6 Gc/s, and universal curves are included which illustrate the effect of changing network parameters and component temperatures.

621.375.9 : 621.372.44 : 621.382.23 **2904**

A Solid-State Analogue to a Travelling-Wave Amplifier.—G. H. Heilmeier. (*Proc. Inst. Radio Engrs*, June 1961, Vol. 49, No. 6, pp. 1079–1080.) An attempt to improve the dispersive properties of multidiode parametric amplifiers was made by placing stacks of varactor diodes inside an L-band helix. Bandwidths of 15–25% and a noise figure of 9·8 dB were obtained.

621.375.9 : 621.372.44 : 621.385.6 **2905**

A Low-Noise Microwave Quadripole Amplifier.—Ashkin. (See 3199.)

621.375.9 : 621.372.44 : 621.385.63 **2906**

Travelling-Wave Analysis of a Class of Parametric Amplifiers Based upon the Hill Equation.—Fredricks. (See 3205.)

GENERAL PHYSICS

537.226 **2907**

Electric Fields and Currents in Dielectrics.—E. I. Adirovich. (*Fiz. Tverdogo Tela, Leningrad*, 1960, Vol. 2, No. 7, pp. 1410–1422.) A general solution is given for the distribution of electric field and charge-carrier concentration in a dielectric between two metallic contacts when field-emission and thermionic currents flow from the cathode.

537.311.3 **2908**

Potentials in a Conductor of Varying Cross-Section.—R. Jaggi. (*Phys. Rev.*, 15th April 1961, Vol. 122, No. 2, pp. 448–449.) The importance of the eigen-Hall effect [see 1497 of 1954 (Busch & Jaggi)] in masking the Bernoulli voltage in experimental measurements is pointed out.

537.525: 538.69: 621.314.6 **2909**

Rectification Effect in Gaseous Discharges in Crossed Magnetic and Electric Fields.—G. Boucher & O. Doehler. (*C. R. Acad. Sci., Paris*, 4th July 1960, Vol. 251, No. 1, pp. 59–61.) Description of an experimental crossed-field diode consisting of two coaxial electrodes of stainless-steel tube, the inner electrode being filled with a ferrite stack separated by pieces of soft iron. Results obtained with a hydrogen-filled tube under a pressure of 10^{-4} Torr, show that the system is more efficient if the magnetic field is localized near the inner electrode in this manner.

537.533.8 **2910**

The Theory of Secondary-Electron Emission of Metals: Part I.—G. Bimschas. (*Z. Phys.*, 16th Dec. 1960, Vol. 161, No. 2, pp. 190–204.)

537.56 + 537.311.33 **2911**

Complex Conductivity of some Plasmas and Semiconductors.—P. H. Fang. (*Appl. sci. Res.*, 1961, Vol. B9, No. 1, pp. 51–64.) "The complex conductivities of plasmas and semiconductors have been calculated for several cases where the collision frequency can be expressed as a power function of the energy. From the result, some characteristic parameters of the plasma originally investigated by Spitzer are estimated. The problem of determining the relaxation time from a non-symmetrical dispersion is discussed."

537.56 **2912**

Couette Flow of a Fully Ionized Gas, considered as a Two-Component Fluid.—L. A. Peletier & L. van Wijngaarden. (*Appl. sci. Res.*, 1961, Vol. B9, No. 2, pp. 141–150.)

537.56 **2913**

Experimental Study of the Diamagnetism of Gaseous Plasmas with Electron and Nuclear Spin Resonance Techniques.—T. C. Marshall & L. Goldstein. (*Phys. Rev.*, 15th April 1961, Vol. 122, No. 2, pp. 367–376.)

537.56: 538.56 **2914**

Energy Conversion Mechanism in a Bounded Magnetized Current-Carrying Plasma.—G. H. Joshi. (*Phys. Rev. Lett.*, 1st April 1961, Vol. 6, No. 7, pp. 339–341.) For a finite plasma, coupling exists between quasi-transverse e.m. waves and quasi-longitudinal space-charge waves. This can lead to an energy transfer between the kinetic energy of drifting plasma and e.m. energy. This mechanism may be useful for heating a thermonuclear plasma using the 'runaway electrons'. Certain types of v.l.f. radio noise can also be explained.

537.56: 538.564.029.65/.66 **2915**

Emission of Submillimetre Electromagnetic Radiation from Hot Plasma in ZETA.—G. N. Harding, M. F. Kimmitt, J. H. Ludlow, P. Porteous, A. C. Prior & V. Roberts. (*Proc. phys. Soc.*, 1st May 1961, Vol. 77, No. 497, pp. 1069–1075.) The first results are reported of experiments using spectroscopy in the far infrared (0·1–1·6 mm).

537.56: 538.6 **2916**

Oscillations of a Plasma in a Static Magnetic Field.—N. Anderson. (*Proc. phys. Soc.*, 1st May 1961, Vol. 77, No. 497, pp. 971–979.) The dielectric tensor is calculated and used together with the solutions to the propagation problem at zero temperature to allow for thermal effects.

537.56: 538.69 **2917**

The Theory of Plasmas in the Presence of Magnetic Fields.—J. Friedrich. (*Z. Phys.*, 22nd Nov. 1960, Vol. 160, No. 5, pp. 494–503.) On the basis of Boltzmann's equation the complete theory of a stationary cylindrical plasma is obtained allowing for the presence of the intrinsic magnetic field and of an additional longitudinal magnetic field.

538.221 **2918**

Statistical Mechanics of Ferromagnetism; Spherical Model as High-Density Limit.—R. Brout. (*Phys. Rev.*, 15th April 1961, Vol. 122, No. 2, pp. 469–474.) The conjecture of the validity of the spherical model (3789 of 1960) is examined and justified.

538.56: 621.396.677.8 **2919**

Measurements on Resonators formed from Circular Plane and Confocal Paraboloidal Mirrors.—E. H. Scheibe. (*Proc. Inst. Radio Engrs*, June 1961, Vol. 49, No. 6, p. 1079.) A measured Q of 260 000 at 3·2 cm λ was obtained, and results were in agreement with those of Fox & Li relating to optical masers (*ibid.*, Nov. 1960, Vol. 48, No. 11, pp. 1904–1905).

538.561: 537.533 **2920**

Cherenkov Radiation in a Dielectric Tube Waveguide.—B. W. Hakki & P. D. Coleman. (*Proc. Inst. Radio Engrs*, June 1961, Vol. 49, No. 6, pp. 1084–1085.) An experimental arrangement for measuring the radiation is described and results are given. High interaction resistances can be obtained at the expense of physical size and mode interference.

538.566: 535.43 **2921**

Shift of the Shadow Boundary and Scattering Cross-Section of an Opaque Object.—S. I. Rubinow & J. B. Keller. (*J. appl. Phys.*, May 1961, Vol. 32, No. 5, pp. 814–820.)

538.566: 535.43 **2922**

Near-Zone Back-Scattering from Large Spheres.—V. H. Weston. (*Appl. sci. Res.*, 1961, Vol. B9, No. 2, pp. 107–116.) Theoretical treatment of back-scatter from a perfectly conducting sphere for short wavelengths. The back-scatter cross-section is modified considerably as the receiver approaches to within a few radii, and becomes the cross-section of a flat plate for a receiver very near the sphere.

538.566: 539.23 **2923**

Reflection and Transmission of Conductive Films.—M. V. Schneider. (*Proc. Inst. Radio Engrs*, June 1961, Vol. 49, No. 6, pp. 1090–1091.) A more general relation for the reflection and transmission coefficients is given for the case of oblique incidence, and perturbations due to frequency dependence and displacement currents are considered. A formula is also derived for thick films. See also 4197 of 1960 (Koide).

538.569.4: 537.525 **2924**

Microwave Zeeman Effect of Free Hydroxyl Radicals.—H. E. Radford. (*Phys. Rev.*, 1st April 1961, Vol. 122, No. 1, pp. 114–130.) The theory of the Zeeman effect in $^2\Pi$ levels of light diatomic radicals is extended to the general intermediate coupling case and used for detailed analysis of observed paramagnetic resonance absorption spectra, at 3 cm λ, of the products of an electric discharge in low-pressure H_2O and D_2O vapour.

538.569.4: 538.222 **2925**

On the Theory of Cross-Relaxation in Maser Materials.—M. Hirono. (*J. Radio Res. Labs, Japan*, Jan. 1961, Vol. 8, No. 35, pp. 1–15.) The cross-relaxation rate is calculated by the method of moments, taking into account the effect of the crystalline electric field.

538.569.4: 621.375.9 **2926**

Phonon Masers and the Phonon Bottleneck.—C. Kittel. (*Phys. Rev. Lett.*, 1st May 1961, Vol. 6, No. 9, p. 449.) A calculation shows that the transfer of energy from the electron spin system can set up a stimulated phonon emission leading to maser action.

538.691 **2927**

'Corkscrew'—a Device for Changing the Magnetic Moment of Charged Particles in a Magnetic Field.—R. C. Wingerson. (*Phys. Rev. Lett.*, 1st May 1961, Vol. 6, No. 9, pp. 446–448.) A helical field source is described which produces a monotonic increase or decrease in the transverse energy of a particle moving initially in the uniform field along the helix axis.

539.2 **2928**

Higher Random-Phase Approximations in the Many-Body Problem.—H. Suhl & N. R. Werthamer. (*Phys. Rev.*, 15th April 1961, Vol. 122, No. 2, pp. 359–366.)

"The usual random-phase approximation combined with an equations-of-motion technique for the many-electron problem is extended, yielding many of the known results of series summation methods in a straightforward manner. The method should apply to other types of many-body problems as well."

539.2 : 538.2 **2929**

A Variational Approach to Correlation in an Electron Gas.—W. H. Young. (*Phil. Mag.*, March 1961, Vol. 6, No. 63, pp. 371–377.) A periodic electron density is allowed, and it is proved that there exist one-particle states energetically more favourable than the usual plane-wave orbitals.

GEOPHYSICAL AND EXTRATERRESTRIAL PHENOMENA

523.164 : 621.317.794 **2930**

Digital Radiometer.—Weinreb. (See 3115.)

523.164.3 **2931**

Radio Emission from the Cygnus Loop.—D. S. Mathewson, M. I. Large & C. G. T. Haslam. (*Mon. Not. R. astr. Soc.*, 1960, Vol. 121, No. 6, pp. 543–550.) A high-resolution study of the Cygnus Loop has been made at 408 Mc/s and the results are compared with the optical features. Estimates of the thermal and nonthermal radio emissions are made.

523.164.3 **2932**

Secular Variation of the Flux Density of the Radio Source Cassiopeia A.—D. S. Heeschen & B. L. Meredith. (*Nature, Lond.*, 20th May 1961, Vol. 190, No. 4777, pp. 705–706.) Observations at 1 400 Mc/s support the evidence of Hogbom & Shakeshaft (1492 of May) of a decrease of about 1% per annum in the flux density of Cassiopeia A over the last 12 years.

523.164.3 : 523.42 **2933**

The Microwave Temperature of Venus.—D. E. Jones. (*Planet. Space Sci.*, June 1961, Vol. 5, No. 2, pp. 166–167.) Solar corpuscular radiation may maintain an ionosphere on Venus and the variation in observed brightness temperature may consequently be a function of zenith angle.

523.164.3 : 523.45 **2934**

The Source of Radiation from Jupiter at Decimetre Wavelengths: Part 3—Time Dependence of Cyclotron Radiation.—G. B. Field. (*J. geophys. Res.*, May 1961, Vol. 66, No. 5, pp. 1395–1405.) Part 2 : 3471 of 1960.

523.164.4 **2935**

Radio Emission from the Perseus Cluster.—P. R. R. Leslie & B. Elsmore. (*Observatory*, Feb. 1961, Vol. 81, No. 920, pp. 14–16.) Two small components of the Perseus cluster separated by 350 kpc have been identified. They may be physically related in a similar manner to that of the two emitting regions in Cygnus-A.

523.165 **2936**

The Effects of Betatron Accelerations upon the Intensity and Energy Spectrum of Magnetically Trapped Particles.—P. J. Coleman, Jr. (*J. geophys. Res.*, May 1961, Vol. 66, No. 5, pp. 1351–1361.) The effects of change of magnetic field on the energy spectrum are calculated.

523.165 **2937**

Characteristics and Fine Structure of the Large Cosmic-Ray Fluctuations in November 1960.—J. F. Steljes, H. Carmichael & K. G. McCracken. (*J. geophys. Res.*, May 1961, Vol. 66, No. 5, pp. 1363–1377.) Report and discussion of observations of solar cosmic-ray increases on 12th and 15th November, the former occurring at a time of a sharp Forbush decrease.

523.165 **2938**

Balloon Observations of Auroral-Zone X Rays.—R. R. Brown. (*J. geophys. Res.*, May 1961, Vol. 66, No. 5, pp. 1379–1388.) X rays are detectable about 10% of the time; large increases occur during geomagnetic disturbances.

523.165 **2939**

Seasonal Variations of Cosmic-Ray Intensity in Polar Regions.—K. Marda & V. L. Patel. (*J. geophys. Res.*, May 1961, Vol. 66, No. 5, pp. 1389–1393.)

523.5 : 621.396.96 **2940**

Analysis of a Type of Rough-Trail Meteor Echo.—B. A. McIntosh. (*Canad. J. Phys.*, March 1961, Vol. 39, No. 3, pp. 437–444.) The characteristics of h-type echoes are examined in detail (see also 2226 of 1959). The rough trail may be due to fragmentation of the dust-ball type of meteoroid.

523.5 : 621.396.96 **2941**

The Height Variation of the Ambipolar Diffusion Coefficient for Meteor Trails.—J. S. Greenhow & J. E. Hall. (*Planet. Space Sci.*, June 1961, Vol. 5, No. 2, pp. 109–114.) Both the two-station and the split-beam measuring techniques were used. It was concluded that the atmospheric scale height during winter at a height of 90 km above Jodrell Bank (53° 14' N) is 8·0 km.

523.75 : 523.165 **2942**

Delayed Propagation of Solar Cosmic Rays on September 3, 1960.—J. R. Winckler, P. D. Bhavsar, A. J. Masley & T. C. May. (*Phys. Rev. Lett.*, 1st May 1961, Vol. 6, No. 9, pp. 488–491.) An analysis of balloon, rocket and ground-level observations reveals that the delay between the flare and the arrival of solar protons increases with decrease in proton energy.

523.75 : 523.165 **2943**

Rocket Observations of Solar Protons on September 3, 1960.—L. R. Davis, C. E. Fichtel, D. E. Guss & K. W. Ogilvie. (*Phys. Rev. Lett.*, 1st May 1961, Vol. 6, No. 9, pp. 492–494.) The results of nuclear-emulsion and G-M counter observations are used to derive the integral and differential spectra for protons of energy 10–200 MeV arriving at the top of the atmosphere.

550.385.4 **2944**

Magnetic Disturbances and the Earth's Magnetic Field.—J. S. Chatterjee. (*J. geophys. Res.*, May 1961, Vol. 66, No. 5, pp. 1535–1546.) Storm-time changes in the earth's magnetic field could induce currents in the earth's core which interact with the steady field. This produces a nett unidirectional current at the end of the disturbance which penetrates gradually down to the core and has a decay time of a million years. This current could be responsible for maintaining the steady field.

550.385.4 **2945**

Solar Corpuscular Showers and Families of Geomagnetic Storms.—V. I. Afanas'eva. (*Dokl. Ak. Nauk S.S.S.R.*, 11th Dec. 1960, Vol. 135, No. 5, pp. 1120–1122.) Investigation of the effect of corpuscular showers in producing (*a*) magnetic storms and (*b*) magnetic disturbances during which the corpuscular showers pass near the earth without enveloping it.

550.385.4 : 523.165 **2946**

The Ring Current, Geomagnetic Disturbance, and the Van Allen Radiation Belts.—S. I. Akasofu & S. Chapman. (*J. geophys. Res.*, May 1961, Vol. 66, No. 5, pp. 1321–1350.) The negative phase of a magnetic storm is ascribed to the formation of a ring current at a distance about four earth's radii from the earth's center. The magnetic field due to the current is calculated and compared with observational results.

551.507.362.1 : 523.165 **2947**

Radiation Measurements during the Flight of the Third Space Rocket.—S. N. Vernov, A. E. Chudakov, P. V. Vakulov, E. V. Gorchakov, Yu. I. Logachev & A. G. Nikolaev. (*Dokl. Ak. Nauk S.S.S.R.*, 11th Jan. 1961, Vol. 136, No. 2, pp. 322–324.) Preliminary analysis of results of instrument recordings made during the flight of the rocket between the 6th and 18th October 1959.

551.507.362.2 **2948**

Secondary-Electron Emission and the Satellite Ionization Phenomenon.—D. B. Medved. (*Proc. Inst. Radio Engrs*, June 1961, Vol. 49, No. 6, pp. 1077–1078.) Electron emission from a satellite and the electron density variation near it due to bombardment by neutral particles are considered.

551.507.362.2 **2949**

Sputtering as a Possible Mechanism for Increase of Ionization in the Vicinity of Low-Altitude Satellites.—G. D. Magnuson & D. B. Medved. (*Planet. Space Sci.*, June 1961, Vol. 5, No. 2, pp. 115–121.) An increase in ionization above ambient may occur at distances of up to 1 mean path from the satellite. Ionization potentials of the injected atoms are $\frac{1}{4}$ to $\frac{1}{2}$ those of the ambient species. The probability of any collision leading to ionization should exceed 10^{-4} with the model proposed, for the mechanism to be of interest.

551.507.362.2 **2950**

The Effect of Atmospheric Rotation on the Orbital Plane of a Near-Earth

Satellite.—G. E. Cook & R. N. A. Plimmer. (*Proc. roy. Soc. A*, 8th Nov. 1960, Vol. 258, No. 1295, pp. 516–528.) Theoretical formulae are derived for the motion of the orbital plane and change in orbital inclination of a near-earth satellite due to the influence of the atmosphere.

551.507.362.2: 523.165 **2954**

Satellite Determination of Heavy Primary Cosmic-Ray Spectrum.—M. A. Pomerantz, S. P. Agarwal, P. Schwed & H. Hasson. (*Phys. Rev. Lett.*, 1st April 1961, Vol. 6, No. 7, pp. 362–364.) A preliminary report of the heavy-nuclei cosmic-ray flux observed aboard Explorer VII is given.

551.507.362.2: 621.391.812.5 **2952**

Drop-Out Phenomena Observed in the Satellite 1958 δ_2 Transmissions.—L. Liszka. (*J. geophys. Res.*, May 1961, Vol. 66, No. 5, pp. 1573–1577.) Irradiation of the quartz oscillator in 1958 δ_2 during passage through the horns of the outer Van Allen belt may explain 'dropouts'—sudden decreases of observed signal strength.

551.507.362.2 + 523.5): 621.396.96 **2953**

Sideband Construction of Lunar and Solar Satellite Reflection Signals in the 100–Mc/s Range.—R. E. Anderson. (*Proc. Inst. Radio Engrs.*, June 1961, Vol. 49, No. 6, pp. 1081–1082.) Measurements are described and records of signal variation are illustrated. With lunar reflections a correlation of 0·1 was obtained between sidebands with 0 (c/s separation; the correlation of signals reflected from Echo balloon with 20 (c/s sideband separation was better than that of lunar reflections with 300 c/s separation.

551.510.53 **2954**

Production of Carbon in the Upper Atmosphere.—K. P. Ghosh. (*Planet. Space Sci.*, June 1961, Vol. 3, No. 2, pp. 168–176.) Before decaying, very fast neutrons originating from disintegrations by high-energy cosmic ray particles may collide with nitrogen atoms to produce ^{14}C and ^{3}H. This 'neutron capture' should result in carbon and hydrogen atoms and traces of cyanogen gas being present in the upper atmosphere, while by-products of the mechanism may contribute significantly to the formation of the inner radiation belt.

551.510.535 **2955**

Studies of the E Layer of the Ionosphere: Part 2—Electromagnetic Perturbations and Other Anomalies.—E. V. Appleton & A. J. Lyon. (*J. atmos. terr. Phys.*, June 1961, Vol. 21, Nos. 2/3, pp. 73–99.) Departures from the predictions of simple theory in observed E-layer behaviour are attributed to perturbations arising from the motor effect of the S_q system of currents flowing there. The main effect is to raise f_0E near noon in low latitudes and reduce it in high latitudes. The departure of f_0E from proportionality to $(\cos \chi)^{1/3}$, and other anomalies are also discussed. Part 1: 1432 of 1957.

551.510.535 **2956**

Note on the Role of Small Layers with Irregular Surfaces in the Formation of Sporadic-E Layers.—J. Voge. (*Ann. Télécommun.*, Jan.–Feb. 1961, Vol. 16, Nos. 1/2, pp. 62–63.) In earlier work by du Castel et al. (*ibid.*, Jan.–Feb. & May–June 1960, Vol. 15, Nos. 1/2 & 5/6, pp. 39–47 & 107–142) irregularities in the refractive index of the troposphere have been represented by a model which has now been adapted to the E_s layer. The reflection coefficients calculated using the model are of the right order of magnitude.

551.510.535 **2957**

Irregularities in the E_s Layer of the Ionosphere.—G. F. Fooks. (*Nature, Lond.*, 20th May 1961, Vol. 190, No. 4777, pp. 707–708.) Correlation analysis shows no systematic elongation at Cambridge (52°N, 0°E) in contrast to the E–W elongation of auroral, and N–S elongation of equatorial type of E_s. There is a wide range of sizes in the scale of the irregularities in the diffraction pattern on the ground.

551.510.535 **2958**

Considerations of the F Layer in the Ionosphere.—S. Ishikawa & S. Hirotomi. (*J. Radio Res. Labs, Japan*, Jan. 1961, Vol. 8, No. 35, pp. 29–40.) A graphical statistical description of the diurnal, seasonal and annual variations of f_0F_1 at Kokubunji and information on the relation between f_0F_1 and f_0F_2.

551.510.535 **2959**

Diurnal Variation of F Region Drifts at Waltair.—E. S. Rao & B. R. Rao. (*Curr. Sci.*, Jan. 1961, Vol. 30, No. 1, pp. 9–10.) The results of F_2 region drift measurements for the four seasons in the years 1956–1958 are given. See also 2282 of 1958.

551.510.535 **2960**

Equatorial Spread-F at Ibadan, Nigeria.—A. J. Lyon, N. J. Skinner & R. W. Wright. (*J. atmos. terr. Phys.*, June 1961, Vol. 21, Nos. 2/3, pp. 100–110.) Spread-F characteristics are closely related to the height of the layer; the irregularities may be due to hydromagnetic disturbances, which are increasingly attenuated at lower heights. See also 679 of March.

551.510.535 **2961**

Variation in Height of Anisotropy and Random Drift Velocity of the Irregularities in the Ionosphere.—B. R. Rao & K. V. V. Ramana. (*Nature, Lond.*, 20th May 1961, Vol. 190, No. 4777, pp. 706–707.) Correlation analysis shows that the axial ratio of the anisotropy ellipse and the random change factor $(V_c/_\omega V$ are both greatest for waves reflected from heights of 270–290 km.

551.510.535 **2962**

Possible Identification of Atmospheric Waves associated with Ionospheric Storms.—M. D. Wright. (*Nature, Lond.*, 3rd June 1961, Vol. 190, No. 4779, pp. 898–899.) The onset time of an ionospheric storm is defined as the time of first increase at *h'F* and the velocity is determined by measuring the time delay at Godley Head, 1 105 km north of Campbell Island. The mean northward velocity for eight well-defined storms was found to be in the range 406–691 m/s and may correspond to the velocity of a neutral gaseous wave as indicated by the Johnston Island nuclear explosion disturbance, i.e. 470 m/s.

551.510.535 **2963**

A Method of Calculation of N(h) Profiles from Ionospheric h'(f) Curves.—H. Hojo. (*J. Radio Res. Labs, Japan*, Jan. 1961, Vol. 8, No. 35, pp. 41–57.) See 1569 of May.

551.510.535 **2964**

A New Method for the Analysis of Ionospheric h'(f) Records.—J. E. Titheridge. (*J. atmos. terr. Phys.*, April 1961, Vol. 21, No. 1, pp. 1–12.) A method is given for calculating the real heights of reflection in the ionosphere, from the observed virtual heights. The real height is assumed to be a polynomial in the plasma frequency.

551.510.535 **2965**

General Expression for the Group Refractive Index of the Ionosphere.—V. S. N. Murty & S. R. Khastgir. (*J. atmos. terr. Phys.*, April 1961, Vol. 21, No. 1, pp. 65–68.) A general expression for the group refractive index of the ionosphere is found in which wave frequency, electron density and collision frequency, magnetic field and direction of propagation are variables. See also 2001 of 1960.

551.510.535: 517.64 **2966**

A Solution of the Integral Equation $h'(f) = \int_\mu (f, f_0 N) d(f_0 N)$.—H. Uno. (*J. atmos. terr. Phys.*, April 1961, Vol. 21, No. 1, pp. 40–45.) A method involving power series expansions is given for solving the integral equation. One advantage of the method is the use of a set of master curves which applies for all stations.

551.510.535: 523.745 **2967**

A Study of the Variations in a Daily Ionospheric Index of Solar Activity.—G. H. Barnard. (*J. atmos. terr. Phys.*, June 1961, Vol. 21, Nos. 2/3, pp. 103–107.) A table of daily values of $f_0 = f_0^4 \sec \chi$ at Slough is given for 1958. The short-term variations in f_0 from July 1957–December 1958 are examined by statistical methods and it is shown that these variations are related to changes in the sun.

551.510.535: 523.746 **2968**

A Long-Term Variation in the Relationship of Sunspot Numbers to E-Region Character Figures.—R. Naismith, H. C. Bevan & P. A. Smith. (*J. atmos. terr. Phys.*, June 1961, Vol. 21, Nos. 2/3, pp. 167–173.) The statistical relation between sunspot number and monthly mean values of $Ch_E = f_E^4 \sec \chi$ at Slough suggests that from 1933 onwards, there has been a decrease in the value of Ch_E corresponding to a given sunspot number.

551.510.535: 523.75 **2969**

Solar Flare Effects in the F Region of the Ionosphere.—R. W. Knecht & K. Davies. (*Nature, Lond.*, 27th May 1961, Vol. 190, No. 4778, pp. 797–798.) Increases in f_0F_2 were observed during flares in 1949 and 1956 which were accompanied by increases in sea-level cosmic-ray intensity. Similar increases in f_0F_2 are reported in

November 1960 at two stations and simultaneous falls in isoionic heights of 10–20 km were also observed.

551.510.535: 539.16 **2970**

Sporadic-E Phenomena associated with the High-Altitude Nuclear Explosions over Johnston Island.—L. Thomas & R. E. Taylor. (*J. atmos. terr. Phys.*, June 1961, Vol. 21, Nos. 2/3, pp. 205–208.) Marked increases in E_s occurred near latitudes 60° N and S and are attributed to the explosions.

551.510.535: 550.385.2 **2971**

Magnetic Effects in the F Region of the Ionosphere.—J. W. King. (*J. atmos. terr. Phys.*, April 1961, Vol. 21, No. 1, pp. 26–34.) Nighttime values of f_0F_2 at stations in the south of Africa are found to decrease with increasing values of the equivalent planetary daily amplitude A_p. The magnetic control of nighttime ionization could account for the day-to-day correlation of f_0F_2 values. The relation of ionospherically and magnetically quiet days is discussed.

551.510.535: 621.3.085 **2972**

Automatic Ionogram Scaler.—M. Onoye, F. Ochi, N. Omiya & K. Arai. (*J. Radio Res. Labs, Japan*, Jan. 1961, Vol. 8, No. 35, pp. 59–63.) An instrument has been designed which projects an ionogram on to a screen. The parameters which are read off are recorded simultaneously on punched tapes and in typewritten form. The tape can be used to produce punched cards if required.

551.510.535: 621.3.087.4 **2973**

Active High-Frequency Spectrometers for Ionospheric Sounding: Part 3—Determination of True-Height from the Virtual Height of Reflection.—A. K. Paul. (*Arch. elekt. Übertragung*, Oct. 1960, Vol. 14, No. 10, pp. 468–476.) A new method for determining true height is described (see also 2591 of August) and its application to daytime and nighttime soundings discussed. Part 2: 2597 of August (Rawer).

551.510.535: 621.3.087.4 **2974**

A New Type of Ionospheric Drift Recorder.

—B. R. Rao & R. R. Rao. (*J. atmos. terr. Phys.*, June 1961, Vol. 21, Nos. 2/3, pp. 208–210.) A method of eliminating photographic and pen recording of fading signals and the laborious calculations. A tape recorder is used to introduce a variable time delay into one aerial feed. When this delay equals that of the received signals a minimum is obtained. Delays of 0·07–1·5 sec have been measured.

551.510.535: 621.391.812.63 **2975**

Day-to-Day and Station-to-Station Correlation of Ionospheric F-Region Critical Frequencies.—J. W. King. (*J. atmos. terr. Phys.*, April 1961, Vol. 21, No. 1, pp. 35–39.) The correlation of simultaneous f_0F_2 values at stations separated by 1 700 km in a north-south direction is found to have a semi-diurnal variation, the phase of which varies with season. Results at a single station show an important autocorrelation for values at the same time on consecutive days, and this is ascribed to magnetic effects.

551.510.535: 621.391.812.63 **2976**

Year-to-Year Changes in the Winter Anomaly in Ionospheric Absorption.—L. Thomas. (*J. atmos. terr. Phys.*, June 1961, Vol. 21, Nos. 2/3, pp. 215–217.) The mean anomalous component in a given winter is linearly related to the mean magnetic C figure for the same winter.

551.510.535(98): 523.75 **2977**

Some Characteristics of Solar Corpuscular Radiations which Excite Abnormal Ionization in the Polar Upper Atmosphere.—K. Sinno. (*J. Radio Res. Labs, Japan*, Jan. 1961, Vol. 8, No. 35, pp. 17–28.) Statistical data on the time delay from the occurrence of a major flare until the onset of polar absorption, have been studied. It is suggested that particles ejected from the sun may be trapped in a corpuscular cloud which may later intersect a magnetic line of force along which particles can travel to reach the earth.

551.510.536 **2978**

The Coupling between the Protonosphere and the Normal F Region.—W. B. Hanson & I. B. Ortenburger. (*J. geophys. Res.*, May 1961, Vol. 66, No. 5, pp. 1425–1435.) In the protonosphere, above about 900 km, the distribution of protons is determined by diffusion rather than chemical processes: this region is independent of diurnal changes in the ionosphere.

551.510.62 **2979**

Continuous Recordings for the Determination of the Vertical Gradient of the Refractive Index in the Free Atmosphere.—H. P. Barthelt & A. Rossbach. (*Nachrichtentech. Z.*, Oct. 1960, Vol. 13, No. 10, pp. 462–464.) Report on measurements made by equipment mounted at six different levels on a 160-m tower to determine the correlation between the refractive-index gradient and field-strength fluctuations over a 250-km radio-link path.

551.510.62 **2980**

The Radio Refractive Index Gradient over the British Isles.—J. A. Lane. (*J. atmos. terr. Phys.*, June 1961, Vol. 21, Nos. 2/3, pp. 157–166.) Airborne microwave refractometer measurements made in the British Isles confirm that the quantity $(n-1)$ varies exponentially with height. The variations in the parameters are less than those in the U.S.A. There is a high correlation between the surface value of $(n-1)$ and the average decrease in the refractive index in the first kilometre of altitude.

551.594.21 **2981**

A Criterion for Thunderstorm Theories.—J. A. Chalmers. (*J. atmos. terr. Phys.*, June 1961, Vol. 21, Nos. 2/3, pp. 174–176.) Results on the charging and external currents of the same storm favour the classical theory rather than the convection theories. See 165 of 1960.

551.594.5 **2982**

Aurora and Airglow from Colour Film Observations.—B. P. Sandford. (*J. atmos. terr. Phys.*, June 1961, Vol. 21, Nos. 2/3, pp. 177–181.) Summary of experience using colour film records.

551.594.5: 621.396.96 **2983**

Investigation of Auroral Echoes: Part 2.—L. Harang & J. Tröim. (*Planet. Space Sci.*, June 1961, Vol. 5, No. 2, pp. 105–108.) Ratios of measured echo signal strength at 40 and 80, and 40 and 120 Mc/s showed that the frequency dependence of the reflection coefficient is qualitatively explained by either an inverse λ^8 law (partial reflection from large surfaces) or an $\exp(-k\lambda^4)$ law (scattering from field-aligned irregularities). Part 1: 1175 of April.

551.594.6 **2984**

Narrow-Band Atmospherics from Two Local Thunderstorms.—F. Horner. (*J. atmos. terr. Phys.*, April 1961, Vol. 21, No. 1, pp. 13–25.) Atmospherics from two storms were studied. Reception frequencies of 11 Mc/s and 6 kc/s were used with power bandwidths in the range 200–300 c/s. Duration, peak amplitude, mean field strength and mean power flux were calculated. Results conflict with some theories of the origin of atmospherics.

551.594.6 **2985**

On the Extremely-Low-Frequency Spectrum of Earth–Ionosphere Cavity Response to Electrical Storms.—H. R. Raemer. (*J. geophys. Res.*, May 1961, Vol. 66, No. 5, pp. 1580–1583.) A comparison of the observed and calculated spectra in the range 5–33 c/s.

551.594.6 **2986**

Simultaneous Observations of V.L.F. Noise ('Hiss') at Hobart and Macquarie Island.—R. L. Dowden. (*J. geophys. Res.*, May 1961, Vol. 66, No. 5, pp. 1587–1588.) The noise sources seem to be small in size and to have different locations at 4 and 9 kc/s.

551.594.6 **2987**

Dispersions of Multiple-Stroke Whistlers.—N. D. Clarence & P. A. O'Brien. (*Nature, Lond.*, 17th June 1961, Vol. 190, No. 4781, pp. 1096–1097.) Analysis of I.G.Y. records at Durban indicates a 4–6% increase in the dispersion of successive components of multiple-stroke short whistlers, which supports the current-jet hypothesis of whistler generation.

LOCATION AND AIDS TO NAVIGATION

621.396.663.089.6 **2988**

Problems of Calibration of Two-Channel Cathode-Ray Direction Finders.—G. Kattner & W. Rohrbeck. (*Nachr Tech.*, Sept. 1960, Vol. 10, No. 9, pp. 392–397.) Methods of calibrating and checking the calibration of direction finders are outlined, including one for periodically interchanging the two channels.

621.396.932.2: 627.95 **2989**

Marine Distress Beacon.—K. Jirsa. (*Telefunken Ztg*, Dec. 1960, Vol. 33, No. 130, pp. 290–294.) Description of a floating distress beacon operating at 2·182 Mc/s using battery-driven transistor circuits and the ferrite-rod aerial detailed in 4223 of 1959 (Baur & Ziehm).

621.396.963 + 534.88 **2990**

Video Integration in Radar and Sonar Systems.—D. C. Cooper & J. W. R. Griffiths. (*J. Brit. Instn Radio Engrs*, May 1961, Vol. 21, No. 5, pp. 421–433.) The performance of ideal and practical systems, including the influence of aerial beam width, is examined. A new double delay-loop integrator giving a small improvement in threshold detection and having some practical advantages is described.

621.396.963.325 **2991**

Nonlinear Effects in Rotating-Coil P.P.I. Displays.—R. H. C. Morgan. (*Mullard tech. Commun.*, March 1961, Vol. 5, No. 47, pp. 252–258.) "Nonlinearity effects of the three coaxial deflection coils in a p.p.i. display system and methods to minimize them by means of careful coil design and adjustment, are discussed."

MATERIALS AND SUBSIDIARY TECHNIQUES

535.215 **2992**

Theory of the Photomagnetic Effect in Cubic Anisotropic Crystals.—A. A. Grinberg. (*Fiz. Tverdogo Tela*, July 1960, Vol. 2, No. 7, pp. 1361–1367.)

535.215: 537.311.33 **2993**

Determination of Recombination Constants from the Spectral Characteristics of a Photocell with a *p-n* Junction: Part 2.—G. B. Dubrovskiĭ & V. K. Subashiev. (*Fiz. Tverdogo Tela*, July 1960, Vol. 2, No. 7, pp. 1562–1571.) The analysis of Part 1 [1871 of June (Subashiev)] is applied to photocells obtained by diffusion of donor impurities in *p*-type Si.

535.215: 539.23 **2994**

Photoconductivity of Sulphur Layers Treated with Mercury Vapour.—M. I. Korsunskiĭ, N. S. Pastushuk & G. D. Mokhov. (*Fiz. Tverdogo Tela*, July 1960, Vol. 2, No. 7, pp. 1581–1583.) Treated layers, of resistance $< 10^6\Omega$, showed simultaneous positive and negative photoconductivity of large inertia. In the short-wavelength region ($\lambda = 453$ mμ) negative photoconductivity predominated; in the long-wavelength region ($\lambda = 645$ mμ) only positive photoconductivity was observed.

535.215: 546.47'221 **2995**

An Investigation of the Induced Conductivity in Thin Zinc Sulphide Layers.—A. A. Didenko, Yu. A. Nemilov & V. I. Fomina. (*Fiz. Tverdogo Tela*, July 1960, Vol. 2, No. 7, pp. 1434–1440.)

535.215: 546.48'221 **2996**

The Contribution of Ions to the Current through CdS at High Temperatures.—K. W. Böer & H. Gutjahr. (*Mber. dtsch. Akad. Wiss. Berlin*, 1960, Vol. 2, No. 6, pp. 324–327.) Experimental investigations indicate that up to a temperature of 430°C the ion current is less than 0·1%. See also 2241 of July (Böer et al.).

535.215: 546.48'221 **2997**

An Investigation of the Lux/Ampere Characteristics of CdS Single Crystals.—E. A. Sal'kov & G. A. Fedorus. (*Fiz. Tverdogo Tela*, July 1960, Vol. 2, No. 7, pp. 1576–1580.) Results of photocurrent measurements are at variance with theory [see e.g. 768 of 1956 (Rose) and 3102 of 1958 (Bube)].

535.215: 546.48'221 **2998**

Intermittent-Light Method for the Measurement of Capture Cross-Sections for Traps in Cadmium Sulphide.—E. A. Niekisch. (*Z. Phys.*, 1st Dec. 1960, Vol. 161, No. 1, pp. 38–45.) The method described in 2972 of 1955 is used to determine capture cross-sections for shallow traps near the conduction band in CdS crystals.

535.215: 546.48'221 **2999**

Current Noise and Distributed Traps in Cadmium Sulphide.—J. J. Brophy. (*Phys. Rev.*, 1st April 1961, Vol. 122, No. 1, pp. 26–30.) Measurements of noise as a function of frequency in a single crystal, at different temperatures and levels of illumination, give a $1/f$ trapping noise spectrum of the form $(1/\omega)$ arc tan $\omega\tau$. Values of τ are obtained from the low-frequency turnover point, and give trap depths which are in good agreement with discrete trapping levels determined from other measurements.

535.215: 546.48'221 **3000**

Fine Structure and Magneto-optic Effects in the Exciton Spectrum of Cadmium Sulphide.—J. J. Hopfield & D. G. Thomas. (*Phys. Rev.*, 1st April 1961, Vol. 122, No. 1, pp. 35–52.) Detailed experimental study of the magneto-optic absorption spectrum of direct excitons formed from the top valence band and the conduction band, and theoretical interpretation of results. See also 1641 of 1960 (Thomas & Hopfield).

535.215: 546.48'241 **3001**

The Optical Properties of Cadmium Telluride in the Far Infrared Region.—A. Mitsuishi. (*J. phys. Soc. Japan*, March 1961, Vol. 16, No. 3, pp. 533–537.)

535.37: 546.47'221: 535.215 **3002**

Impedance Changes Induced by Light in ZnS Phosphors.—I. Uchida & K. Satake. (*J. phys. Soc. Japan*, March 1961, Vol. 16, No. 3, p. 573.) The impedance change of a capacitor containing a phosphor is interpreted in terms of an equivalent circuit and used to derive the photoconductivity.

535.376 **3003**

A New Electroluminescence Effect in Black Carborundum.—A. G. Gol'dman. (*Dokl. Ak. Nauk S.S.S.R.*, 11th Dec. 1960, Vol. 135, No. 5, pp. 1108–1110.) Samples are prepared by applying to *p*-type material a sensitive *n*-type layer. When acted upon by current in the forward direction a luminescence is produced at the *p-n* junction.

535.376 **3004**

The Field Enhancement in ZnS.CdS-Mn Phosphors with X-Ray Excitation.—H. Winkler, H. Röppischer & G. Wendel. (*Z. Phys.*, 28th Dec. 1960, Vol. 161, No. 3, pp. 330–338.) The results of experimental investigations differ to some extent from those of other authors. The 'memory' effect described by Destriau (1213 of 1959) was observed as a consequence of field action alone before X-ray excitation.

535.376: 546.47'221 **3005**

Direct-Current Electroluminescence at Low Voltages.—W. A. Thornton. (*Phys. Rev.*, 1st April 1961, Vol. 122, No. 1, pp. 58–59.) Electroluminescence can occur at applied voltages corresponding to only about half the band gap of a ZnS phosphor; hence the acceleration-collision theory is ruled out at low voltage.

535.376: 546.47-31 **3006**

Excitation of Zinc Oxide by Slow Electrons.—P. Wachter. (*Z. Phys.*, 1st Dec. 1960, Vol. 161, No. 1, pp. 62–73.) Investigations of low-energy excitation of ZnO phosphors were carried out with an electron beam of small velocity spread; a theoretical interpretation of the results is given.

537.226: 546.47'221: 539.23 **3007**

On the Dielectric Properties of Thin Films of Zinc Sulphide.—R. Fuchshuber, R. Guillien & S. Roizen. (*C. R. Acad. Sci., Paris*, 4th July 1960, Vol. 251, No. 1, pp. 51–53.)

537.227 **3008**

Dielectric Properties of Solid Solutions of Sodium Niobate-Lead Zirconate and Sodium Niobate-Lead Titanate.—W. R. Bratschun & R. L. Cook. (*J. Amer. ceram. Soc.*, 1st March 1961, Vol. 44, No. 3, pp. 136–140.)

537.227 **3009**

Variation of Permittivity with Electric Field in Perovskite-Like Ferroelectrics.—H. Diamond. (*J. appl. Phys.*, May 1961, Vol. 32, No. 5, pp. 909–915.) Variation of incremental permittivity is shown to be associated with an induced ferroelectric state rather than being directly a property of domain processes; large variations with field must be accompanied by strong thermal sensitivity.

537.227 **3010**

Bismuth Titanate: a Ferroelectric.—L. G. Van Uitert & L. Egerton. (*J. appl. Phys.*, May 1961, Vol. 32, No. 5, p. 959.) Results of measurements of d.c. resistivity, dielectric constant, and hysteresis loops are given.

537.227: 546.431'824-31 **3011**

Optical Absorption and Electrical Conductivity of Reduced $BaTiO_3$ Single Crystal.—S. Ikegami, I. Ueda & Y. Ise. (*J. phys. Soc. Japan*, March 1961, Vol. 16, No. 3, pp. 572–573.)

537.227: 547.476.3 **3012**

The Effect of a Constant Electric Field on the Hysteresis of Rochelle Salt.—K. N. Karmen. (*Fiz. Tverdogo Tela*, July 1960, Vol. 2, No. 7, pp. 1671–1675.) A circuit used for recording hysteresis curves during simultaneous application of steady and variable fields of different intensities is shown. Symmetric and asymmetric hysteresis loops are identified and discussed.

537.227: 547.476.3: 539.12.04 **3013**

Ferroelectric Properties of X-Ray-Damaged Rochelle Salt.—K. Okada. (*J. phys. Soc. Japan*, March 1961, Vol. 16, No. 3, pp. 414–423.)

537.311.33 **3014**

Semiconducting Properties of the $AgFeTe_2$ Phase.—E. L. Shtrum. (*Fiz. Tverdogo Tela*, July 1960, Vol. 2, No. 7, pp. 1489–1493.)

537.311.33 **3015**

The Effect of Trapping Levels in Semiconductors on Steady-State Photoconductivity and on the Lifetime of Nonequilibrium Current Carriers.—A. A. Grinberg, L. G. Paritskiĭ & S. M. Ryvkin. (*Fiz. Tverdogo Tela*, July 1960, Vol. 2, No. 7, pp. 1545–1561.) A quantitative investigation is made of the effects of trapping levels introduced into the crystal on carrier recombination under steady-state conditions due to the presence of other traps in the forbidden zone. The effect of the filling of trapping levels on the variation of carrier lifetimes and photoconductivity as a function of temperature and light intensity is discussed.

537.311.33 **3016**

Long-Range Interactions between Magnetic Moments in Semiconductors.—W. Baltensperger & A. M. de Graaf. (*Helv. phys. Acta*, 15th Nov. 1960, Vol. 33, No. 8, pp. 881–888.) The interaction between magnetic moments in a nondegenerate electron gas is calculated, and account is taken of the additional interaction arising from virtual excitations of the valence band in semiconductors.

537.311.33 **3017**

Micro-masking for Chemical Etching of Semiconductors.—S. Denda. (*Solid-State Electronics*, Jan. 1961, Vol. 2, No. 1, p. 69.) A method of producing a picrin mask down to 30 μ diameter.

537.311.33 **3018**

Theoretical Calculations of the Enthalpies and Entropies of Diffusion and Vacancy Formation in Semiconductors.—R. A. Swalin. (*J. Phys. Chem. Solids*, March 1961, Vol. 18, No. 4, pp. 290–296.) The covalent-bond approach is used to obtain kinetic parameters.

537.311.33 **3019**

One-Dimensional Overlap Functions and their Application to Auger Recombination in Semiconductors.—A. R. Beattie & P. T. Landsberg. (*Proc. roy. Soc. A*, 8th Nov. 1960, Vol. 258, No. 1295, pp. 486–495.) Certain overlap integrals, occurring as a temperature-independent parameter in a previous paper (3341 of 1959), are evaluated. Used in conjunction with the previous theory, good agreement is obtained with experimental results.

537.311.33 **3020**

Theory of the Auger Neutralization of Ions at the Surface of a Diamond-Type Semiconductor.—H. D. Hagstrum. (*Phys. Rev.*, 1st April 1961, Vol. 122, No. 1, pp. 83–113.)

537.311.33 **3021**

Semiconducting Properties of Inorganic Amorphous Materials.—H. L. Uphoff & J. H. Healy. (*J. appl. Phys.*, May 1961, Vol. 32, No. 5, pp. 950–954.) Nine materials in the systems As: Se: Te and As: S: Te were tested. Resistivity varied exponentially with temperature; the Seebeck coefficient varied linearly.

537.311.33: 535.211 **3022**

Photothermal Effect in Semiconductors.—W. W. Gärtner. (*Phys. Rev.*, 15th April 1961, Vol. 122, No. 2, pp. 419–424.) The establishment of a temperature distribution in a solid by optically excited diffusing and recombining carriers is called the photothermal effect. Theory is developed.

537.311.33: 538.567 **3023**

Detection of Millimetre- and Submillimetre-Wave Radiation by Free-Carrier Absorption in a Semiconductor.—B. V. Rollin. (*Proc. phys. Soc.*, 1st May 1961, Vol. 77, No. 497, pp. 1102–1103.) The change in conductivity when radiation is absorbed by free carriers can be used for detection at mm and sub-mm λ. The sensitivity for *n*-type InSb at a temperature of about 2°K is estimated.

537.311.33: 538.614 **3024**

Theory of Interband Faraday Rotation in Semiconductors.—B. Lax & V. Nishina. (*Phys. Rev. Lett.*, 1st May 1961, Vol. 6, No. 9, pp. 464–467.) The interband Faraday rotation and its dependence on frequency is examined by using a quantum-mechanics approach to calculate the rotations for the indirect and direct forbidden transitions.

537.311.33: 538.63 **3025**

Influence of Conductivity Gradients on Galvanomagnetic Effects in Semiconductors.—R. T. Bate & A. C. Beer. (*J. appl. Phys.*, May 1961, Vol. 32, No. 5, pp. 800–805.) An approximate solution is found of a boundary-value problem arising from the continuity equation in an inhomogeneous semiconductor. Experimental results indicate that transverse currents, which do not occur in the simple case discussed, do appear in general.

537.311.33: 546.24 **3026**

Infrared Absorption and Structure of the Hole Band of Tellurium.—V. M. Korsunskiĭ & M. P. Liitua. (*Fiz. Tverdogo Tela*, July 1960, Vol. 2, No. 7, pp. 1619–1623.)

537.311.33: 546.28 **3027**

Absorption of Infrared Radiation by Electrons in *p*-Type Silicon.—V. A. Yakovlev. (*Fiz. Tverdogo Tela*, July 1960, Vol. 2, No. 7, pp. 1624–1628.)

537.311.33: 546.28 **3028**

Problems related to *p-n* Junctions in Silicon.—W. Shockley. (*Solid-State Electronics*, Jan. 1961, Vol. 2, No. 1, pp. 35–67.) A simple model of the behaviour of holes and electrons in the high reverse fields of *p-n* junctions is shown to account well for secondary ionization, avalanche breakdown and microplasma phenomena. Statistical spatial fluctuations of donors and acceptors are shown to have significant effects on avalanche breakdown. Typical noisy microplasma phenomena are probably associated with structural defects whose properties are specified.

537.311.33: 546.28 **3029**

Impurity Effect upon Mobility in Heavily Doped Silicon.—Y. Furukawa. (*J. phys. Soc. Japan*, March 1961, Vol. 16, No. 3, p. 577.) A similar effect was obtained to that previously observed in heavily doped Ge (see 2941 of 1960).

537.311.33: 546.28 **3030**

Some Experiments using a Vacuum-Cleaved Silicon *p-n* Junction.—J. T. Law. (*J. appl. Phys.*, May 1961, Vol. 32, No. 5, pp. 848–855.) Changes in the junction characteristics during the adsorption of oxygen and hydrogen have been investigated. In the clean condition the valence band edge was 0·13–0·14 eV below the Fermi level. A large excess current across the clean junction disappeared during adsorption of gas.

537.311.33: 546.28: 539.12.04 **3031**

The Effect of Fast-Electron Bombardment on the Electrical Conductivity of Silicon and the Dependence of the Rate of Defect Formation on the Orientation of a Crystal with respect to the Electron Beam.—V. S. Vavilov, V. M. Pankevich, B. Ya. Yurkov & P. Ya. Glazunov. (*Fiz. Tverdogo Tela*, July 1960, Vol. 2, No. 7, pp. 1431–1433.)

537.311.33: 546.289 **3032**

The Mechanism of Carrier Scattering in *p*-Type Germanium.—M. N. Vinogradova, O. A. Golikova, B. P. Mironov & L. S. Stil'bans. (*Fiz. Tverdogo Tela*, July 1960, Vol. 2, No. 7, pp. 1429–1430.)

537.311.33: 546.289 **3033**

Effect of Linear Dislocations on Charge Carrier Recombination in *p*-Type Germanium.—M. I. Iglitsyn & L. I. Kolesnik. (*Fiz. Tverdogo Tela*, July 1960, Vol. 2, No. 7, pp. 1542–1544.)

537.311.33: 546.289 **3034**

Investigation of the Kinetics of Fast Surface States on Germanium.—V. G. Litovchenko & V. I. Lyashenko. (*Fiz. Tverdogo Tela*, July 1960, Vol. 2, No. 7, pp. 1592–1596.) Report of field-effect and photoconductivity measurements on high-resistivity *n*- and *p*-type Ge.

537.311.33: 546.289 **3035**

Measurements of the Anomalous Transmission Factor and of the Reflection of X-Rays on Good Germanium Single Crystals for the Bragg Case of Interference: Comparison with the Dynamic Theory of X-Ray Diffraction.—U. Bonse. (*Z. Phys.*, 20th Dec. 1960, Vol. 161, No. 3, pp. 310–329.)

537.311.33: 546.289 **3036**

Impurity Concentrations in the Regrown Region of In-Ge Alloyed Junctions.—F. L. Roberts. (*Solid-State Electronics*, Jan. 1961, Vol. 2, No. 1, pp. 9–13.) The development of an infrared microscope for routine carrier-density measurements on small semiconducting specimens is described.

The results of a study made with it of In-Ge and In-Ga-Ge recrystallized alloyed regions are given.

537.311.33: 546.289 **3037**

Regrowth of Germanium Single Crystal from Indium Melt.—M. Tomono. (*J. phys. Soc. Japan*, March 1961, Vol. 16, No. 3, pp. 439–453.)

537.311.33: 546.289 **3038**

Hot-Electron Nonequilibrium Carrier Distribution in a Many-Valley Semiconductor.—L. Gold. (*J. phys. Soc. Japan*, March 1961, Vol. 16, No. 3, pp. 575–576.) Results of a study of the contribution of nonuniform charge density to the ellipsoidal energy surfaces in Ge are given. A reasonable deviation of collinear current and voltage directions is obtained; thus measurements of this quantity may be useful in studies of effective mass and carrier density.

537.311.33: 546.289 **3039**

Cyclotron Resonance in Germanium.—R. R. Gualtieri. (*Phys. Rev.*, 15th April 1961, Vol. 122, No. 2, pp. 397–405.) A comparison is made of cyclotron resonance theory and experimental data [see 1093 of 1956 (Fletcher et al.)]. Values of effective mass constants which best fit the data are found.

537.311.33: 546.289 **3040**

Generation-Recombination Noise in *p*-type Gold-Doped Germanium.—L. J. Neuringer & W. Bernard. (*Phys. Rev. Lett.*, 1st May 1961, Vol. 6, No. 9, pp. 455–457.) A theory is developed which accounts for the noise observed in interacting two-level systems and shows good quantitative agreement with experimental observations on Au-doped Ge.

537.311.33: 546.289 **3041**

Third-Order Elastic Moduli of Germanium.—T. Bateman, W. P. Mason & H. J. McSkimin. (*J. appl. Phys.*, May 1961, Vol. 32, No. 5, pp. 928–936.)

537.311.33: 546.289: 535.215 **3042**

A New Effect of Negative Photoconductivity in a Magnetic Field.—A. A. Grinberg, S. R. Novikov & S. M. Ryvkin. (*Dokl. Ak. Nauk S.S.S.R.*, 11th Jan. 1961, Vol. 136, No. 2, pp. 329–331.) A note on effects observed in a *p*-type Ge sample illuminated in the direction of an applied magnetic field.

537.311.33: 546.289: 535.215 **3043**

Modulation of Light by means of an Electric Field.—B. H. Clausen. (*Proc. phys. Soc.*, 1st May 1961, Vol. 77, No. 497, pp. 1100–1101.) A note of experiments on the modulation of light reflected at a Ge surface when the carrier density was varied by means of an applied electric field. Results show that the modulation was a function of the dielectric used as a field plate rather than a function of the Ge surface.

537.311.33: 546.289: 538.614 **3044**

Faraday Effect for Direct Magneto-optical Transitions in Germanium.—M. Suffczyński. (*Proc. phys. Soc.*, 1st May 1961, Vol. 77, No. 497, pp. 1042–1045.) The Faraday effect due to the interband magneto-optical transitions in Ge is calculated. The direct transitions from the uppermost Landau levels of the two light-hole ladders and two heavy-hole ladders are considered. Measurement of the Faraday rotation offers a sensitive means of studying the effective masses of the levels in the presence of the magnetic field.

537.311.33: 546.289: 538.63 **3045**

Galvanomagnetic Effects in n-Ge in the Impurity Conduction Range.—R. J. Sladek & R. W. Keyes. (*Phys. Rev.*, 15th April 1961, Vol. 122, No. 2, pp. 487–492.) The measured magnitude and the crystalline anisotropy of the magnetoresistance are interpreted in terms of the changes in the donor wave functions produced by the magnetic field. The field dependence of the Hall coefficient is interpreted as a magnetoresistance effect of the conduction band.

537.311.33: 546.289: 539.12.04 **3046**

The Action of Radiation on Semiconductors: Recombination Centres Introduced in Germanium by 2-Mev Electrons.—P. Baruch. (*Ann. Phys., Paris*, Jan.–Feb. 1961, Vol. 6, Nos. 1/2, pp. 23–79.)

537.311.33: 546.289: 539.23 **3047**

Textural Properties of Germanium Films.—J. E. Davey. (*J. appl. Phys.*, May 1961, Vol. 32, No. 5, pp. 877–880.)

537.311.33: 546.26-1 **3048**

Some Optical and Electrical Properties of Semiconducting Diamonds.—A. Halperin & J. Nahum. (*J. Phys. Chem. Solids*, March 1961, Vol. 18, No. 4, pp. 297–306.)

537.311.33: 546.3-1'289'28 **3049**

Magnetic Susceptibility of Ge-Si Mixed Crystals.—G. Busch & O. Vogt. (*Helv. phys. Acta*, 15th Nov. 1960, Vol. 33, No. 8, pp. 959–960. In German.) Susceptibility was measured as a function of temperature for 34 samples in the temperature range 300–1 200°K. The results are compared with those of measurements of cyclotron resonance and magnetoresistance.

537.311.33: 546.3-1'289'28 **3050**

Lattice Thermal Conductivity of Germanium-Silicon Alloy Single Crystals at Low Temperatures.—A. M. Toxen. (*Phys. Rev.*, 15th April 1961, Vol. 122, No. 2, pp. 450–458.)

537.311.33: 546.431'824-31 : 621.316.825.2 **3051**

Semiconducting Bodies in the Family of Barium Titanates.—O. Saburi. (*J. Amer. ceram. Soc.*, 1st Feb. 1961, Vol. 44, No. 2, pp. 54–63.) The resistivity/temperature characteristics of the semiconducting Ba titanates are examined to determine compositions suitable for the construction of positive-type thermistors.

537.311.33: 546.47'241 : 546.60'221 **3052**

Some Electrical Properties of Zinc Telluride-Cadmium Sulphide Heterojunctions.—M. Aven & D. M. Cook. (*J. appl. Phys.*, May 1961, Vol. 32, No. 5, pp. 960–961.) Techniques for preparing the junctions at room temperatures are described. Rectification ratios up to 5×10^5 were obtained with a CdS film and about 10^3 with a ZnTe film. The *I-V* characteristic of a CdS-film junction is given.

537.311.33: 546.48'19 **3053**

Galvanomagnetic Properties of *n*-Type CdSe.—A. S. Fischler. (*Phys. Rev.*, 15th April 1961, Vol. 122, No. 2, pp. 475–478.)

537.311.33: 546.561-31 **3054**

Electrical Conductivity of Single-Crystal Cuprous Oxide at High Temperatures.—R. S. Toth, R. Kilkson & D. Trivich. (*Phys. Rev.*, 15th April 1961, Vol. 124, No. 2, pp. 402–408.)

537.311.33: 546.682'86 **3055**

Optical Investigation of the Band Structure of GaSb.—M. Cardona. (*Z. Phys.*, 1st Dec. 1960, Vol. 161, No. 1, pp. 99–102.) The reflectivity of GaSb was measured at photon energies between 0·5 and 5 eV; the structure observed is similar to that of Ge.

537.311.33: 546.681'86 **3056**

Dissociation Coefficients of Impurities in Gallium Antimonide.—R. N. Hall & J. H. Racette. (*J. appl. Phys.*, May 1961, Vol. 32, No. 5, p. 856.)

537.311.33: 546.682'18 **3057**

Optical Studies of the Band Structure of InP.—M. Cardona. (*J. appl. Phys.*, May 1961, Vol. 32, No. 5, p. 958.)

537.311.33: 546.682'86 **3058**

Infrared Cyclotron Resonance in InSb.—E. D. Palik, G. S. Picus, S. Teitler & R. F. Wallis. (*Phys. Rev.*, 15th April 1961, Vol. 122, No. 2, pp. 475–481.)

537.311.33: 546.682'86: 538.569.4 **3059**

Cyclotron Resonance in Indium Antimonide at High Magnetic Fields.—B. Lax, J. G. Mavroides, H. J. Zeiger & R. J. Keyes. (*Phys. Rev.*, 1st April 1961, Vol. 122, No. 1, pp. 31–35.) An improved theoretical treatment is given which accounts satisfactorily for various sets of experimental data.

537.311.33: 546.682'86: 538.63 **3060**

Magnetoresistance and Hall Effect in Oriented Single-Crystal Samples of *n*-Type Indium Antimonide.—C. H. Champness. (*Canad. J. Phys.*, March 1961, Vol. 39, No. 3, pp. 452–467.)

537.311.33: 546.682'86: 538.63 **3061**

Influence of Magnetoconductivity Discontinuities on Galvanomagnetic Effects in Indium Antimonide.—R. T. Bate, J. C. Bell & A. C. Beer. (*J. appl. Phys.*, May 1961, Vol. 32, No. 5, pp. 806–814.) Observations are predicted qualitatively by considering a simple model consisting of a long thin specimen having a discontinuity in resistivity and Hall coefficient in the current direction. The boundary-value problem is solved for this case.

537.311.33: 546.683'23 **3062**

Certain Properties of Thallium Selenide Single Crystals.—G. A. Akhundov, G. B. Abdullaev & G. D. Guseĭnov. (*Fiz. Tverdogo Tela*, July 1960, Vol. 2, No. 7, pp. 1510–1521.)

537.311.33 : 546.873'221 **3063**

Some Semiconducting Properties of Bismuth Trisulphide.—I. Gildart, J. M. Kline & D. M. Mattox. (*J. Phys. Chem. Solids*, March 1961, Vol. 18, No. 4, pp. 286–289.) Preparation of single crystals, dendrites and crystalline films is described. Data are given for the thermal energy gap of films, optical energy gap, resistivity, carrier concentration and mobility, thermal conductivity and Seebeck coefficient for single crystals.

537.311.33 : 621.391.822 **3064**

Approximate Solution to Semiconductor Noise as a Queuing Problem.—T. L. Saaty. (*Proc. Inst. Radio Engrs*, June 1961, Vol. 49, No. 6, p. 1095.) An alternative treatment to that of Bell (3897 of 1958) indicating the possible usefulness of the queuing representation for low frequencies.

537.312.62 **3065**

The Surface Impedance of Normal and Superconducting Indium at 3 000 Mc/s.—P. N. Dheer. (*Proc. roy. Soc. A*, 7th March 1961, Vol. 260, No. 1302, pp. 333–349.) From impedance measurements, a value is obtained for the penetration depth λ_0, and the Fermi surface area is estimated.

537.312.62 **3066**

Superconducting Tunnelling on Bulk Niobium.—M. D. Sherrill & H. H. Edwards. (*Phys. Rev. Lett.*, 1st May 1961, Vol. 6, No. 9, pp. 460–461.) Measurements of tunnelling current for Nb-Pb junctions are described.

537.312.62 : 539.23 **3067**

An Upper Limit for the Resistivity of a Superconducting Film.—R. F. Broom. (*Nature, Lond.*, 10th June 1961, Vol. 190, No. 4780, pp. 992–993.) A persistent current was induced in a Pb-In film at 2·1°K. Hall-effect probe measurements showed the resistivity to be $<10^{-10}$ Ω. cm.

537.533.8 **3068**

Reflection of Slow Electrons from Tungsten Single Crystals, Clean and with Adsorbed Monolayers.—P. Kisliuk. (*Phys. Rev.*, 15th April 1961, Vol. 122, No. 2, pp. 405–411.) Experimental results are described and considered in relation to theory and previous experimental work. The technique permits continuous recording of the change in work function as gas is adsorbed.

537.533.8 : 539.23 **3069**

Certain Regularities in the Secondary Electron Emission from Thin Metal Layers and Semiconductors.—I. M. Bronshteĭn & B. S. Fraĭman. (*Dokl. Ak. Nauk S.S.S.R.*, 11th Dec. 1960, Vol. 135, No. 5, pp. 1097–1100.) Experimental investigation of the relation between δ and η for thin layers of Ca, Be, Ba or Ti applied respectively to base layers of Be, Ca, Ti, or Ba, where δ and η are the coefficients of slow secondary emission and inelastic reflection.

538.22 : 538.569.4 **3070**

Nuclear Quadruple Resonance in an Antiferromagnet.—J. C. Burgiel, V. Jaccarino & A. L. Schawlow. (*Phys. Rev.*, 15th April 1961, Vol. 122, No. 2, pp. 629–636.)

538.221 **3071**

The Magnetic Field above the Surface of a Plate-Shaped Domain Structure with Bloch-Wall and Surface Poles.—C. Greiner. (*Mber. dtsch. Akad. Wiss. Berlin*, 1960, Vol. 2, No. 6, pp. 328–336.) The field distribution is calculated.

538.221 **3072**

Magnetic Properties of Ce_2O_3.—M. C. Cadeville & A. J. P. Meyer. (*C. R. Acad. Sci., Paris*, 17th Oct. 1960, Vol. 251, No. 16, pp. 1621–1622.)

538.221 **3073**

A Method of Analysis of the Magnetic History of Ferromagnetic Specimens by means of the Preisach Diagram.—H. Seidel. (*Z. angew. Phys.*, Nov. 1960, Vol. 12, No. 11, pp. 493–501.) The Preisach diagram [see e.g. 842 of 1957 (Feldtkeller & Wilde)] can be used to analyse the magnetization processes which a specimen has undergone previously. Discrepancies between theory and measurements relating to Rayleigh's constant are discussed, and the use of the principle in the development of storage-type devices is indicated.

538.221 **3074**

The Influence of Internal Magnetic Couplings on the Shape of Preisach Functions of High-Permeability Materials.—H. Gürke. (*Z. angew. Phys.*, Nov. 1960, Vol. 12, No. 11, pp. 502–508.) Explanation of the unsymmetrical arrangement of Preisach functions already observed [3590 of 1960 (Wilde & Gürke)].

538.221 **3075**

Effects of the Special Heat Treatment on Permalloys.—S. Tomita. (*J. phys. Soc. Japan*, March 1961, Vol. 16, No. 3, pp. 393–396.) Heat treatment of mumetal and 50%Ni-50%Fe permalloy at temperatures from 200°C to 600°C was found to give a marked increase of maximum permeability. The effect is attributed to inhomogeneous internal structure in these materials.

538.221 : 538.569.4 **3076**

Study of the Magnetization in a Single Crystal of Silicon-Iron by Ferromagnetic Resonance.—A. Coumes. (*C. R. Acad. Sci., Paris*, 23rd May 1960, Vol. 250, No. 21, pp. 3458–3460.) The theory of phases of elementary domains leads to a method of determining the true magnetization direction in a phase from the experimental resonance curve. See 978 of March.

538.221 : 539.23 **3077**

Measurements on the Magnetic Anisotropy in Evaporated Iron Films.—R. Vrambout & L. De Greve. (*Appl. sci. Res.*, 1961, Vol. B9, No. 2, pp. 102–106.)

538.221 : 539.23 : 538.691 **3078**

The Magnetic Deflection of Electron Beams in Thin Iron Films.—H. Boersch, W. Raith & H. Weber. (*Z. Phys.*, 1st Dec. 1960, Vol. 161, No. 1, pp. 1–12.) Experimental investigations of the effect of film thickness, and the internal magnetic field, on the angle of deflection of an electron beam passing through the film.

538.221 : 621.318.124 : 538.569.4 **3079**

Ferromagnetic-Resonance Line Width in Cobalt-Substituted Ferrites.—C. W. Haas & H. B. Callen. (*Phys. Rev.*, 1st April 1961, Vol. 122, No. 1, pp. 39–48.)

538.221 : 621.318.132 **3080**

Possibilities of Modifying the Magnetic Properties of Permalloy Alloys.—F. Pfeifer. (*Elektrotech. Z., Edn A*, 19th Dec. 1960, Vol. 81, No. 26, pp. 985–989.) Important characteristics of permalloy-type materials can be modified by high-temperature annealing and by tempering. The results of experimental investigations on various alloys are given and discussed.

538.221 : 621.318.134 **3081**

Effect of Boron on Square-Loop Cadmium Manganese Ferrites.—E. E. Eichhorn. (*J. Amer. ceram. Soc.*, 1st Feb. 1961, Vol. 44, No. 2, pp. 51–54.) A ferrite toroid dipped in boron solution before heat treatment possesses much lower coercivity than an undipped core. The switching time, Curie point and UV_s/UV_d ratio are also reduced.

538.221 : 621.318.134 **3082**

Exchange Anisotropy in Mixed Manganites with the Hausmannite Structure.—L. S. Jacobs & J. S. Kouvel. (*Phys. Rev.*, 15th April 1961, Vol. 122, No. 2, pp. 412–418.)

538.221 : 621.318.134 **3083**

Magnetic Torque Curves for a Single Crystal of Thulium Orthoferrite ($TmFeO_3$).—C. Kuroda, T. Miyadai, A. Naemura, N. Niizeki & H. Takata. (*Phys. Rev.*, 15th April 1961, Vol. 122, No. 2, pp. 446–447.) Experimental results indicate that a previously proposed model [1956 of 1959 (Sherwood et al.)] should be modified.

538.221 : 621.318.134 : 548.5 **3084**

Growth of Single-Crystal Iron Ferrites by the Czochralski Method.—F. H. Horn. (*J. appl. Phys.*, May 1961, Vol. 32, No. 5, pp. 900–901.)

538.222 : 538.569.4 **3085**

Effect of Configuration Mixing and Covalency on the Energy Spectrum of Ruby.—S. Sugano & M. Peter. (*Phys. Rev.*, 15th April 1961, Vol. 122, No. 2, pp. 381–386.)

539.23 : 537.533.7 **3086**

Hot Electrons in Metal Films: Injection and Collection.—J. P. Spratt, R. F. Schwarz & W. M. Kane. (*Phys. Rev. Lett.*, 1st April 1961, Vol. 6, No. 7, pp. 341–342.) A device is described in which quantum tunnelling electrons are emitted into a thin metal film. The structure facilitates the separation of these hot electrons. The characteristics of the device are given which show that it could be used as an amplifier.

[illegible] **3087**

Radio-Frequency Technique for Pulling Oxide Crystals without employing a Crucible Susceptor.—F. R. Monforte, F. W. Swarthout & L. G. Van Uitert. (*J. appl. Phys.*, May 1961, Vol. 32, No. 5, pp. 959–961.) Details are given of a water-cooled r.f. induction-heating coil which keeps the centre part of the charge molten and the outer part solid.

MATHEMATICS

517.542.2 **3088**

Simplifying the Fourier Integral by Adequate Specification.—C. G. Mayo & J. W. Head. (*Brit. J. appl. Phys.*, May 1961, Vol. 12, No. 5, pp. 240–246.) Use of a limiting numerical form of definition of the impulse function is shown to be superior to the normal idealized Dirac function in removing ambiguities such as those occurring in an analysis of the voltage developed across a resistance with residual shunt capacity when a current impulse is applied.

517.64: 534.320.181 **3089**

A Solution of the Integral Equation $\phi(f) = \int_0^\infty \{f(\xi)\phi(\xi)\}\,d\xi$.—Uno. (See 2966.)

517.948 **3090**

Taylor-Cauchy Transforms for Analysis of Varying-Parameter Systems.—Y. H. Ku. (*Proc. Inst. Radio Engrs, June* 1961, Vol. 49, No. 6, pp. 1096–1097.) Six examples are given. See 2853 of 1960 (Ku et al.).

518.4: 621.372.5 **3091**

Graphs with Two Kinds of Elements.—S. L. Hakimi. (*J. Franklin Inst.*, Dec. 1960, Vol. 270, No. 6, pp. 451–467.) Fundamental properties of graphs with red and black elements are studied and the procedures given are modified to find the number of poles and zeros of network functions of an *RLC* network.

519.281.2 **3092**

A New Technique for Increasing the Flexibility of Recursive Least-Squares Data Smoothing.—N. Levine. (*Bell Syst. tech. J.*, May 1961, Vol. 40, No. 3, pp. 821–840.) Optimum, or arbitrary, weights can be assigned to the observations, and the restriction of a constant data interval can be removed without affecting the optimum weighting or recursive features.

MEASUREMENTS AND TEST GEAR

529.786: 621.3.018.41 (083.74) **3093**

Results of a Long-Range Clock Synchronization Experiment.—F. H. Reder, M. R. Winkler & C. Bickart. (*Proc. Inst. Radio Engrs*, June 1961, Vol. 49, No. 6, pp. 1028–1052.) Propagation and synchronization experiments are described to examine the possibility of setting up a world-wide network of synchronized atomic clocks. Synchronization is first established by using an atomic clock which is flown from the master to the slave clock and then maintained by phase tracking a v.l.f. signal controlled by the master clock.

537.311.33: [546.28 + 546.289 **3094**

A Quick and Accurate Method for Measuring the Thickness of Diffused Layers in Silicon and Germanium.—R. Jansen. (*Solid-State Electronics*, Jan. 1961, Vol. 2, No. 1, pp. 59–67.) A cleavage technique is described which permits accurate microscopic measurement of layer thickness.

621.3.018.41 (083.7) **3095**

Caesium Frequency Standards: Description and Results.—P. Kartaschoff, J. Rinaudo & J. De Prins. (*Helv. phys. Acta*, 31st Dec. 1960, Vol. 33, No. 9, pp. 968–973. In French.) Brief information concerning the two standards at the Swiss Horological Research Laboratory, Neuchâtel, includes records of frequency comparisons made with other Cs standards from June to September 1960.

621.317: 621.382.3 **3096**

Transistors in Measurement Techniques: Properties and Application.—Schneider. (See 3187.)

621.317.3: 621.394.422 **3097**

Measuring Amplitude and Phase.—N. R. Goodman. (*J. Franklin Inst.*, Dec. 1960, Vol. 270, No. 6, pp. 437–450.) The amplitude and phase of moderately wide-band noise and noise contaminated by extraneous noise can be determined from a pair of finite moving averages on the sample noise record. The method is applicable to radio-star scintillation data.

621.317.3.088 **3098**

Accuracy in A.C. Measurements.—G. H. Rayner & A. Felton. (*J. Instn elect. Engrs*, March 1961, Vol. 7, No. 75, pp. 141–144.) Absolute values of inductance and capacitance can be obtained to an accuracy within 10–20 parts in 10^6, while calibration accuracy is within 30–100 parts in 10^6. Voltage and current at frequencies up to 50 kc/s can be measured to within 1 part in 10^6, and power and energy to within 5 parts in 10^6.

621.317.313: 621.314.224 **3099**

Techniques for the Calibration of Standard Current Transformers up to 20 kc/s.—J. J. Hill. (*Proc. Instn elect. Engrs*, Part B, May 1961, Vol. 108, No. 39, pp. 333–336. Discussion, pp. 337–338.)

621.317.32: 621.375.13.029.4 **3100**

The Design of an Audio-Frequency Amplifier for High-Precision Voltage Measurement.—S. Harkness & F. J. Wilkins. (*Proc. Instn elect. Engrs*, Part B, May 1961, Vol. 108, No. 39, pp. 319–326. Discussion, pp. 337–338.) The amplifier is based on the 'ring-of-three' feedback circuit and gives a number of fixed gains between 1 and 1 000 in the frequency range 30 c/s–30 kc/s.

621.317.321: 537.311.33 **3101**

Concerning a Rapid Method of Precise Measurement of Thermal E.M.F. of Semiconductors.—O. V. Emel'yanenko & F. P. Kesamanly. (*Fiz. Tverdogo Tela*, July 1960, Vol. 2, No. 7, pp. 1494–1496.) Contact thermocouples with controlled heating are used.

621.317.331: 537.311.33 **3102**

Equipment for Measuring and Recording the Resistance of Semiconductors in Accordance $\log R = f(1/T)$.—L. G. Sapogin & V. M. Ivlev. (*Fiz. Tverdogo Tela*, July 1960, Vol. 2, No. 7, pp. 1482–1488.) The equipment comprises a logarithmic and a hyperbolic amplifier, circuit details of which are given.

621.317.331: 537.311.33 **3103**

An A.C. Bridge for Semiconductor Resistivity Measurements using a Four-Pulse Probe.—M. A. Logan. (*Bell Syst. tech. J.*, May 1961, Vol. 40, No. 3, pp. 885–909.)

621.317.335 **3104**

Improvements in the Precision Measurement of Capacitance.—G. H. Rayner & L. H. Ford. (*Proc. Instn elect. Engrs*, Part B, May 1961, Vol. 108, No. 39, pp. 337–338. Discussion on 2123 of 1960.)

621.317.337: 621.372.413 **3105**

The Effects of Parasitic Modulation on the Accuracy of Measurement of the *Q*-Factor of a Resonator.—F. H. James. (*Proc. Instn elect. Engrs*, Part B, May 1961, Vol. 108, No. 39, pp. 316–318.) An extension of a previous paper (*ibid.*, Part B, Sept. 1959, Vol. 106, No. 29, pp. 489–494) to cover the case where parasitic modulation is found. Theoretical and experimental results in such a case are given.

621.317.343: 621.315.212 **3106**

Impedance Measurement on Coaxial Cables by means of the Pulse Echo Tester.—R. Codelupi. (*Note Recensioni Notiz.*, Nov./Dec. 1960, Vol. 9, No. 6, pp. 1006–1033.)

621.317.361.018.756: 621.372.57 **3107**

The Applicability of Active Filters to the Measurements of the Frequency Spectra of Pulses.—Jungmeister. (See 2882.)

621.317.373: 621.376.5 **3108**

Measuring Frequency Stability of Pulsed Signals.—R. H. Holman & R. B. Shields. (*Electronics*, 21st April 1961, Vol. 34, No. 16, pp. 61–65.) A method of measuring the phase difference between pulses as a pulse-to-pulse r.m.s. deviation, which does not require synchronization or frequency reference from a signal source.

621.317.7: [621.382.3 + 621.372.5 **3109**

A Loss and Phase Set for Measuring Transistor Parameters and Two-Port Networks between 5 and 250 Mc/s.—D.

Leed & O. Kummer. (*Bell Syst. tech. J.*, May 1961, Vol. 40, No. 3, pp. 841–884.) The maximum inaccuracy is 0·1 dB in loss, and 0·5° in phase. The special problems of broad-band measurement on transistors are reviewed, and details are given of the experimental equipment and the results obtained.

621.317.7: 621.397.6 **3110**

Some New Video Measurement Techniques and Apparatus.—Weaver. (See 3166.)

621.317.74 **3111**

A Transfer-Function Analyser for Linear and Nonlinear Components.—A. K. Choudhury, M. S. Basu & A. K. Mahalanabis. (*Electronic Engng*, June 1961, Vol. 33, No. 400, pp. 382–385.) A method of measuring frequency response, gain and phase is described requiring only normal laboratory components.

621.317.75 **3112**

A Voltage Waveform Analyser.—R. Dehors & G. Seguier. (*C. R. Acad. Sci., Paris*, 23rd May 1960, Vol. 250, No. 21, pp. 3464–3466.) A bridge method of analysis is described in which voltage measurements can be made at any point in the cycle.

621.317.75 **3113**

Phase-Sensitive Wave Analysis.—O. J. Haga & D. Midgley. (*Electronic Technol.*, July 1961, Vol. 38, No. 7, pp. 257–261.) "A method of phase analysis is described in which the input waveform is applied to one input of a multiplier. The other input takes in turn reference sine and cosine waves generated locally at the harmonic frequencies. To maintain phase-coherence, operation is interrupted in alternate fundamental periods, allowing initial conditions to be reset in the reference-wave generator. Results are given for an experimental circuit with a wattmeter performing the function of multiplication."

621.317.79.029.64/.65 **3114**

A Microwave Interferometer with Coherent Background.—A. Boivin & R. Tremblay. (*Canad. J. Phys.*, March 1961, Vol. 39, No. 3, pp. 393–408. In French.) The operation of the instrument is based on the principle of coherent background. The reference signal is distributed over the whole of the image space, using suitably polarized sources and a turnstile aerial for detection. The diffraction pattern is scanned twice to determine both the real and imaginary parts, in Cartesian form, of the distribution of complex amplitude.

621.317.794: 523.164 **3115**

Digital Radiometer.—S. Weinreb. (*Proc. Inst. Radio Engrs*, June 1961, Vol. 49, No. 6, p. 1099.) The power spectrum of cosmic noise is measured, over a 5-Mc/s band, via its autocorrelation function. To eliminate the effects of gain fluctuation, the signal is amplified and limited; the autocorrelation of the resulting square waves is found by a digital technique and, assuming a Gaussian input signal, is transformed to the power spectrum. It is hoped to detect the galactic deuterium line.

621.317.794: 621.396.62.029.65/.66 **3116**

Submillimetre-Wave Radiometry.—Long & Rivers. (See 3143.)

OTHER APPLICATIONS OF RADIO AND ELECTRONICS

526.2: 621.396.9 **3117**

An Electronic Distance Measurement System for Accurate Survey.—(*Proc. Instn Radio Engrs, Aust.*, Jan. 1961, Vol. 22, No. 1, pp. 22–25.) An explanation of the principles and operation of the 'Tellurometer' relating to its application in Australia. See 1980 of 1959 (Wadley) and back references.

535.376.07: 537.227 **3118**

Ferroelectric Scanning of Electroluminescent Displays.—M. Cooperman. (*RCA Rev.*, March 1961, Vol. 22, No. 1, pp. 195–205.) A new scanning method using a $BaTiO_3$ crystal is described.

536.587: 621.382.3 **3119**

The Transistor as a Temperature-Sensing Device in Temperature Control Systems.—J. E. Pallett. (*Electronic Engng*, June 1961, Vol. 33, No. 400, pp. 360–363.) A detailed examination is made of the use of a transistor in a common-base circuit for the detection of small temperature changes.

537.533: 621.9 **3120**

The Electron Beam as a Tool.—S. Panzer & K. H. Steigerwald. (*Elektrotech. Z., Edn A*, 19th Dec. 1960, Vol. 81, No. 26, pp. 925–932.) The techniques reviewed include welding, soldering, cutting, milling, drilling, alloying and vapour deposition.

621.362: 621.387 **3121**

Calculation of the Maximum Efficiency of the Thermionic Converter.—J. H. Ingold. (*J. appl. Phys.*, May 1961, Vol. 32, No. 5, pp. 769–772.)

621.362: 621.387 **3122**

Oscillations and Saturation-Current Measurements in Thermionic Conversion Cells.—R. J. Zollweg & M. Gottlieb. (*J. appl. Phys.*, May 1961, Vol. 32, No. 5, pp. 890–894.) R.f. oscillations in Cs-filled thermionic diodes are interpreted on the basis of a model which assumes the ions oscillate in an excess negative charge potential well outside the cathode.

621.387.462: 537.311.33 **3123**

On the Energy Expended per Electron-Hole Pair Produced in *p-n*-Junction Detectors.—E. Baldinger & W. Czaja. (*Nuclear Instrum. Meth.*, March 1961, Vol. 10, No. 3, pp. 237–239.) Previous work relating to radiation counters [see e.g. *Proc. roy. Soc. A*, 7th July 1954, Vol. 224, No. 1158, pp. 362–373 (Erskine)] indicates that for gases, the energy loss $\epsilon = k_1 + k_2 I$, where k_1 and k_2 are constants and I is the ionization energy of the gas. A similar correlation holds for semiconductors. See also 2753 of August (Baldinger et al.).

PROPAGATION OF WAVES

621.391.812.62 **3124**

Experimental Results with Transhorizon Tropospheric Propagation.—F. du Castel. (*Ann. Télécommun.*, Nov./Dec. 1960, Vol. 15, Nos. 11/12, pp. 255–259.) Results of experimental studies made in the period 1957–1960 are discussed.

621.391.812.62 **3125**

Theories of Tropospheric Propagation Beyond the Horizon.—J. Voge. (*Ann. Télécommun.*, Nov./Dec. 1960, Vol. 15, Nos. 11/12, pp. 260–265.) A review, with 38 references.

621.391.812.62 **3126**

Several Aspects of Radio-Meteorology and Radio-Climatology.—P. Misme. (*Ann. Télécommun.*, Nov./Dec. 1960, Vol. 15, Nos. 11/12, pp. 266–273.) Three aspects are considered: (*a*) investigation of a model atmosphere capable of sustaining transhorizon propagation, (*b*) refraction, (*c*) choice of parameters in radio-climatology.

621.391.812.62: 551.510.62 **3127**

Radio-Climatology Tests in the Congo Basin.—P. Misme. (*Ann. Télécommun.*, Jan./Feb. 1961, Vol. 16, Nos. 1/2, pp. 28–40.) An investigation of the refractive index of the air, its gradient, the stability of the lower atmosphere and the water-vapour pressure at different heights.

621.391.812.62.029.63 **3128**

Some Factors Influencing 3-cm Radio-Wave Propagation Oversea Within and Beyond the Radio Horizon.—F. A. Kitchen, W. R. R. Joy & E. G. Richards. (*Proc. Instn elect. Engrs*, Part B, May 1961, Vol. 108, No. 39, pp. 257–263.) Propagation of 10-Gc/s radio waves over sea did not agree with calculations based on an atmosphere of uniform refractive index gradient. Signal losses of 5–30 dB often occurred within the horizon and were usually accompanied by an interference pattern.

621.391.812.62.029.64 **3129**

Experimental Investigation of the Instantaneous Frequency Structure of Propagation in a Heterogeneous Medium.—J. Biggi, F. du Castel, J. C. Simon, A. Spizzichino & J. Voge. (*Ann. Télécommun.*, Nov./Dec. 1960, Vol. 15, Nos. 11/12, pp. 274–276.) Experimental results obtained over a 300-km radio link are given. The transmitter frequency is swept over the range 3·3–3·5 Gc/s in 1/20 s and the received signal analysed as a function of either amplitude or time.

621.391.812.63 **3130**

The Fading of Radio Waves Weakly Scattered at Vertical Incidence from Heights near 90 km.—O. Awe. (*J. atmos. terr. Phys.*, June 1961, Vol. 21, Nos. 2/3, pp. 142–156.) At 2–3 Mc/s the fading rate was about 20 maxima/min. The echo shape is often such as would be expected from a rough screen. Appreciable energy is returned from directions well away from the

vertical. The fading is due to random movements of the scattering elements whose r.m.s. velocity is about 13 m/s.

621.391.812.63 **3131**

The Fading of Radio Waves Reflected from the Ionosphere at Oblique Incidence.—O. Awe. (*J. atmos. terr. Phys.*, June 1961, Vol. 21, Nos. 2/3, pp. 120–141.) Pulse transmissions near 2 Mc/s were used. Echoes from 90 km and 120 km had fading periods near 1 min and 6 sec respectively. Diffraction studies suggest that the irregularities near 90 km are horizontal disks while those at 120 km are spherical. Those near 300 km are elongated along the earth's field with an axial ratio of 3 : 1.

621.391.812.63 **3132**

Results of the Approximate Calculation of Space-Wave Field Strength at the Limits of the Transmission-Frequency Range.—B. Beckmann. (*Nachrichtentech. Z.*, Oct. 1960, Vol. 13, No. 10, pp. 470–472.) Examples of the application of the formula given in 306 of 1960 are discussed.

621.391.812.63.029.45 **3133**

Effect of Underground Induced Polarization on E.L.F. Propagation.—H. Raemer. (*J. geophys. Res.*, May 1961, Vol. 66, No. 5, pp. 1596–1597.) The largest possible corrections to the mode parameters are found to be negligible.

621.391.812.63.029.45 **3134**

A Comparison between Theoretical and Experimental Data on Phase Velocity of V.L.F. Radio Waves.—J. R. Wait. (*Proc. Inst. Radio Engrs*, June 1961, Vol. 49, No. 6, pp. 1089–1090.) Fairly good agreement is indicated between the measured phase velocity and mode theory. The ionosphere is assumed to be sharply bounded, with its lower edge at 70 km during the day and 90 km at night.

621.391.812.63.029.45 **3135**

The Numerical Solution of Differential Equations governing the Reflexion of Long Radio Waves from the Ionosphere: Part 4.—D. W. Barron. (*Proc. roy. Soc. A*, 7th March 1961, Vol. 260, No. 1302, pp. 393–408.) Reflexion coefficients calculated for a series of models of the daytime ionosphere in summer by methods described previously, are compared with observed values. The model whose theoretical properties most nearly agree with experimental observations is found and suggestions are made as to how it should be changed. Sunrise and sunset transitions are also discussed and it is shown that the sharp change in reflection coefficients can be explained in terms of a low-level D layer which is only present in the daytime. Part 3: 3455 of 1959 (Barron & Budden).

621.391.812.63.029.62 **3136**

Studies of Ionospheric Forward Scattering using Measurements of Energy Distribution in Azimuth.—W. C. Bain. (*Proc. Instn elect. Engrs*, Part B, May 1961, Vol. 108, No. 39, pp. 241–252.) A marked diurnal variation of the mean bearing of the 37-Mc/s forward-scatter signal was found. This and other results suggested that the scattering process on the 1 740-km link used was due mainly to meteor reflections at night but that during the day turbulent scattering was also of importance.

621.391.812.63.029.62 **3137**

Directional Observations on Delayed Signals on an Ionospheric Forward-Scatter Circuit.—W. C. Bain. (*Proc. Instn elect. Engrs*, Part B, May 1961, Vol. 108, No. 39, pp. 253–256.) A study was made of the mean bearing of the delayed signals arriving at Slough from Gibraltar after reception of the forward-scatter signal. Results for the first two of these to arrive at Slough are given, and also details of round-the-world echoes. See also 3136 above.

621.391.812.63.029.63 **3138**

The Effect of Faraday Rotation on Incoherent Back-Scatter Observations.—G. H. Millman, A. J. Moceyunas, A. E. Sanders & R. F. Wyrick. (*J. geophys. Res.*, May 1961, Vol. 66, No. 5, pp. 1564–1568.) Preliminary observations of incoherent scattering conducted at Trinidad (10·7°N, 61·6°W) with a high-power pulse radar operating at 400 Mc/s are described.

RECEPTION

621.376.23 **3139**

Certain Problems concerning the Detection of Weak Signals.—B. Picinbono. (*Ann. Télécommun.*, Jan./Feb. 1961, Vol. 16, Nos. 1/2, pp. 2–27.) A thesis; for shorter papers on two different aspects of this work see 1630 of May and 2763 of August.

621.391.82: 621.396.73 **3140**

Probabilities of Interference with Mobile Field Radio Derived from a Field-Strength Survey at 59 Mc/s.—D. R. W. Thomas. (*Proc. Instn elect. Engrs*, Part B, May 1961, Vol. 108, No. 39, pp. 264–272.) The variation of field strength at 59 Mc/s with distance was found to agree well with calculations, its distribution at a given distance was found to be log-normal. Probabilities of interference are derived and presented graphically.

621.391.823 **3141**

Radio Interference from Ignition Systems.—A. H. Ball & W. Nethercot. (*Proc. Instn elect. Engrs*, Part B, May 1961, Vol. 108, No. 39, pp. 273–278.) Comparison of American, German and British measuring equipment, techniques and limits. Good agreement was found between the various measuring sets.

621.391.827 **3142**

A Mechanism for Direct Adjacent-Channel Interference.—C. L. Ruthroff. (*Proc. Inst. Radio Engrs*, June 1961, Vol. 49, No. 6, pp. 1091–1092.) The effects of limiters can cause the modulation in a f.m. channel to appear as undistorted modulation in an adjacent channel.

621.396.62.029.65/.66: 621.317.794 **3143**

Submillimetre-Wave Radiometry.—M. W. Long & W. K. Rivers, Jr. (*Proc. Inst. Radio Engrs*, June 1961, Vol. 49, No. 6, pp. 1024–1027.) Greater sensitivity in reception at sub-mm λ will result from the use of a direct detection system using a chopper, square-law detector and narrow band amplifier than will be obtainable with a superheterodyne system.

STATIONS AND COMMUNICATION SYSTEMS

621.376.56: 621.391.82 **3144**

Errors in Detection of R.F. Pulses Embedded in Time Crosstalk, Frequency Crosstalk, and Noise.—E. A. Marcatili. (*Bell Syst. tech. J.*, May 1961, Vol. 40, No. 3, pp. 921–950.) Calculations are given of the probability of error in the detection of r.f. pulses in a combination of Gaussian noise, time crosstalk from two neighbouring pulses, and frequency crosstalk from an adjacent channel. Criteria for the optimum design of a p.c.m. system are discussed.

621.376.56: 621.391.82 **3145**

Time and Frequency Crosstalk in Pulse-Modulated Systems.—E. A. Marcatili. (*Bell Syst. tech. J.*, May 1961, Vol. 40, No. 3, pp. 951–970.) The time and frequency crosstalk between Gaussian r.f. pulses sent via adjacent frequency channels over the same transmission medium is calculated. See also 3144 above.

621.396.41 **3146**

A Study by means of an Analogue Computer of the Spectrum of Compatible Single-Sideband Modulation.—H. Mertens. (*E.B.U. Rev.*, Dec. 1960, No. 64A, pp. 249–258.) Analysis of the signal spectrum produced by the Kahn system of s.s.b. modulation (971 of 1959).

621.396.43: 551.507.362.2 **3147**

Application of Artificial Earth Satellites to Communications on Ultra Short Waves.—M. Dolukhanov. (*Radio, Mosk.*, May 1961, No. 5, pp. 21–22.) A note on satellite period and transmitter power for heights of 1 000, 2 000, 3 000, 4 000, 5 000 and 35 818 km.

621.396.43: 551.507.362.2 **3148**

A Transatlantic Communication Experiment via Echo I Satellite.—W. C. Jakes, Jr. (*Nature, Lond.*, 20th May 1961, Vol. 190, No. 4777, p. 709.) Further details are given to the experiment described in 1306 of April (Carru et al.).

621.396.43: 551.507.362.2 **3149**
: 621.396.677.3

Communications Satellites using Arrays.—R. C. Hansen. (*Proc. Inst. Radio Engrs*, June 1961, Vol. 49, No. 6, pp. 1066–1074.) Automatic angle return arrays are investigated for both passive and active systems. These Van Atta arrays return a signal in the direction of incidence and are effective over at least ± 45°. Thus only partial stabilization or single axis (spin) stabilization need be used, greatly simplifying

the station-keeping orbit control problem. An active Van Atta scheme has inherently high reliability since many of the distributed amplifiers can fail without serious performance degradation. The distributed structure also allows use of low-power solid-state amplifiers.

621.396.65.029.63 **3150**

FM120 2200: Radio Link Installation for 120 Telephony Channels in the 2-Gc/s Band.—(*Telefunken Ztg*, Dec. 1960, Vol. 33, No. 130, pp. 295–323.)

Part 1—Radio-Link System.—E. Willwacher (pp. 295–302, English summary, pp. 334–335).

Part 2—Modulation Equipment.—R. Heer & H. Oberbeck (pp. 302–305, English summary, p. 335).

Part 3—Radio Equipment.—W. Schlotterbeck (pp. 306–309, English summary, p. 335).

Part 4—Design of Aerial Duplexers.—W. Schlotterbeck & E. Willwacher (pp. 309–313, English summary, p. 336).

Part 5—Stand-By Circuit.—J. Goeldner & O. Tegel (pp. 313–318, English summary, p. 336).

Part 6—Equipment for Diversity Reception.—H. Weber (pp. 318–323, English summary, p. 336).

621.396.712 **3151**

B.B.C. Sound Broadcasting 1939–60.—E. L. E. Pawley. (*Proc. Instn elect. Engrs*, Part B, May 1961, Vol. 108, No. 39, pp. 279–302.) A review of progress.

621.396.946 **3152**

Frequency Allocations for Space Communications.—(*Proc. Inst. Radio Engrs*, June 1961, Vol. 49, No. 6, pp. 1009–1015.) The technical aspects of space communications are examined with special attention to the use of satellites for commercial trunking purposes. The influence of system design on frequency allocation and utilization, and associated problems are discussed.

SUBSIDIARY APPARATUS

621-52 **3153**

Theory of Nonlinear Control.—Y. H. Ku. (*J. Franklin Inst.*, Feb. 1961, Vol. 271, No. 2, pp. 108–144.) A review of work in various fields of nonlinear control. 157 references.

621.311.62: 621.383.292 **3154**

Stabilized E.H.T. Supply Unit for Photomultipliers.—H. Constans & D. Vallat. (*Electronic Applic.*, Feb. 1961, Vol. 20, No. 4, pp. 153–158.) Provided the load is substantially constant, the circuit will produce an output voltage of 1 000–2 000 V with an error not exceeding 0·5% during mains fluctuations of ± 10%.

621.311.69: 621.383.5 **3155**

Spectral Response of Solar-Cell Structures.—L. M. Terman. (*Solid-State Electronics*, Jan. 1961, Vol. 2, No. 1, pp. 1–7.) Measurements on Si cells with the *p-n* junction 0·6 to 5·0 μ below the surface show that the short-wave response ($\lambda > 0{\cdot}75$ μ) is relatively increased by making the junction close to the surface, and the long-wave response by making it deeper. Effects of rough and smooth surfaces were also studied.

621.314.63 **3156**

On the Electrical Parameters of some Types of Selenium Rectifier.—I. Kh. Gellirs & P. V. Sharavskil. (*Fiz. Tverdogo Tela*, July 1960, Vol. 2, No. 7, pp. 1441–1449.)

621.316.72: 621.318.3 **3157**

Variable, Precision-Regulated, Low-Voltage High-Current Supply for Large Electromagnets.—R. C. Mobley. (*Rev. sci. Instrum.*, April 1961, Vol. 32, No. 4, pp. 432–433.) Circuit details are given of a power supply with combined electronic- and magnetic-amplifier control delivering currents of 5–200 A at 40 V with regulation and ripple values <0·01%.

TELEVISION AND PHOTOTELEGRAPHY

621.397.12: 621.397.232.6 **3158**

A New Type of Vestigial-Sideband Facsimile System.—K. Kubota & K. Kobayashi. (*Rev. elect. Commun. Lab., Japan*, Jan./Feb. 1961, Vol. 9, Nos. 1/2, pp. 85–90.) A simple system performing homodyne detection and eliminating quadrature distortion, which does not require a.f.c.

621.397.13: 621.395.625.3 **3159**

A Magnetic Wheel Store for Recording Television Signals.—J. H. Wessels. (*Philips tech. Rev.*, 4th Nov. 1960, Vol. 22, No. 1, pp. 1–10.) The device described will store one or two frames of a television signal indefinitely. The recording is made on the periphery of a magnetically coated rotating wheel using a frequency-modulation technique. A useful application in radiology is mentioned.

621.397.132 **3160**

Comparative Investigations of Modified N.T.S.C. Colour Television Systems using Pre- or Post-correction of Gradation.—K. Bernath. (*Rundfunktech. Mitt.*, Dec. 1960, Vol. 4, No. 6, pp. 232–237.) The advantages of pre-correction are established on the basis of experimental results.

621.397.132 **3161**

Colour Television Transmission with Simultaneous Frequency and Amplitude Modulation of the Colour Carrier (F. A. M. Method).—N. Mayer. (*Rundfunktech. Mitt.*, Dec. 1960, Vol. 4, No. 6, pp. 238–252.) The system described combines some of the advantages of the 'Henri de France' (SECAM) system of colour television (see e.g. 3660 of 1960) with those of the N.T.S.C. method. Pictures obtained on monochrome and colour television receivers are reproduced.

621.397.132 **3162**

Trends towards a Common European Standard for Colour Television.—F. Cappuccini. (*Note Recensioni Notiz.*, Nov./Dec. 1960, Vol. 9, No. 6, pp. 993–1005.) The problem of establishing a standard for compatible colour television is related to the unification of European monochrome standards. Particular consideration is given to a 625-line standard with 8-Mc/s channel width.

621.397.331: 621.391 **3163**

Television Band Compression by Contour Interpolation.—D. Gabor & P. C. J. Hill. (*Proc. Instn elect. Engrs*, Part B, May 1961, Vol. 108, No. 39, pp. 303–315.) This method of compression uses redundancies between fields and between frames. The waveband gain is 4 : 1 without deterioration in picture quality. The results of tests in a photomechanical model are given.

621.397.331.24 **3164**

Measurements of Sharpness on Picture Tubes.—W. Schröder. (*Telefunken-Röhre*, Oct. 1960, No. 37, pp. 17–70.) A method is described which permits the measurement of focusing quality at any point on the screen of a television tube. The various factors influencing spot size are discussed with reference to the results of measurements.

621.397.334.2: 778.6 **3165**

Electronic Reversal of Photographic Colour Negatives.—K. Welland. (*Arch. elekt. Übertragung*, Oct. 1960, Vol. 14, No. 10, pp. 441–450.) An experimental flying-spot scanner with three input channels and a display unit is described. Correction and calibration methods are discussed. Colour reproductions of photographically and electronically reversed test pictures are given for comparison.

621.397.6: 621.317.7 **3166**

Some New Video Measurement Techniques and Apparatus.—L. E. Weaver. (*E.B.U. Rev.*, Dec. 1960, No. 64A, pp. 242–248.) Description of techniques and apparatus used by the B.B.C., including a sine-squared pulse and bar generator, a test-waveform generator for nonlinear distortion measurements, and an outline of the spectrum method of measuring random noise (2345 of 1959). For German version see *Rundfunktech. Mitt.*, Feb. 1961, Vol. 5, No. 1, pp. 8–14.

621.397.61 **3167**

Methods and Limitations of Television Camera Techniques.—R. Theile. (*Elektrotech. Z., Edn A*, 5th Dec. 1960, Vol. 81, No. 25, pp. 895–903.) The principles underlying electron-optical image conversion are outlined, and flying-spot scanning and storage-type camera-tube techniques are discussed in greater detail. Picture quality and sensitivity limits are considered in relation to results obtained by photographic means.

621.397.61: 621.396.677.3 **3168**

Dipole Arrays for Transmitter Aerials for Television Bands IV/V.—Laub. (See 2854.)

621.397.62 **3169**

Synchronizing and A.G.C. Circuits in TV Receivers.—E. M. Cherry. (*Proc. Instn*

Radio Engrs, Aust., Feb. 1961, Vol. 22, No. 2, pp. 61–76.) Practical details are given for the design of a high-quality television receiver from fundamental considerations. The design is simple and noncritical.

621.397.62 : 616-001.26 **3170**

Aspects of the Emission of X Rays from Television Receivers.—M. V. Callendar & D. F. White. (*J. Brit. Instn Radio Engrs*, May 1961, Vol. 21, No. 5, pp. 389–400.) Measurements made with a proportional counter of the dose rates from typical picture tubes show the radiation level is considerably less than the recommended level of 0·5 milliröntgens per hour.

621.397.62.004.6 **3171**

Component and Valve Reliability in Domestic Radio and Television Receivers.—D. W. Heightman. (*J. Brit. Instn Radio Engrs*, May 1961, Vol. 21, No. 5, pp. 401–407. Discussion.) Statistical information on the reliability of television receivers is reviewed. Some reasons for failure are examined and suggestions for improvements made.

621.397.63 : 621.395.625.3 **3172**

A Translator-Modulator-Demodulator as used in V.H.F. F.M. Techniques, for Television Tape-Recording Equipment.—H. Fix & W. Habermann. (*Rundfunktech. Mitt.*, Dec. 1960, Vol. 4, No. 6, pp. 222–231.) The modification of the Ampex method of video tape recording to meet the requirements of the C.C.I.R. 625-line standard is discussed. The use of double frequency-changing overcomes most of the quality defects.

621.397.7 **3173**

Television Centre of Greater Moscow. —(*Radio, Mosk.*, Jan. 1961, No. 1, pp. 6–7.) Brief description of a broadcasting tower to be built in Moscow which will have a base diameter of 65 m and a height of 520 m. The station will transmit simultaneously six sound and five television programmes, one being in colour, over a radius of 120–130 km.

TRANSMISSION

621.396.61 : 551.507.362.2 **3174**

Beacon Transmitters and Power Supply for Echo I.—J. G. McCubbin & H. B. Goldberg. (*RCA Rev.*, March 1961, Vol. 22, No. 1, pp. 147–161.) The transmitter has an output of 5–10 mW at 107·94 Mc/s and is mounted with Si solar cells, batteries and aerial on a printed-circuit board 10 in. in diameter.

621.396.61 : 621.396.662.6 **3175**

The Design of a Highly Stable Short-Wave Exciter Stage with Decade Switching in the Range 1·5–30 Mc/s.—H. Valdorf & R. Klinger. (*Frequenz*, Oct. 1960, Vol. 14, No. 10, pp. 335–343.) A crystal-controlled oscillator provides the standard frequency from which the output frequencies are derived by multiplication, mixing and division. Decade switching in 1-kc/s steps and facilities for interpolation are available in the unit described.

VALVES AND THERMIONICS

621.382.2 **3176**

Properties and Applications of Semiconductor Diodes.—H. F. Graves. (*Elektrotech. Z., Edn A*, 24th Oct. 1960, Vol. 81, No. 22, pp. 761–767.) Circuits for class-B and class-C demodulation are given, and diode applications in the field of h.f. and h.v. measurement, and as protective and control devices are briefly reviewed.

621.382.2 **3177**

Investigation of the Characteristics of Germanium Diodes.—I. M. Senderikhin & P. V. Sharavskil. (*Fiz. Tverdogo Tela*, July 1960, Vol. 2, No. 7, pp. 1497–1505.) Static and pulse characteristics of thermistors and Ge point-contact and junction diodes are discussed in relation to thermal effects.

621.382.2 **3178**

Contribution to the Theory of Thermal Breakdown of Germanium Diodes. —I. M. Senderikhin. (*Fiz. Tverdogo Tela*, July 1960, Vol. 2, No. 7, pp. 1506–1517.) The reverse characteristics of Ge point-contact and junction diodes are analysed and general theory of thermal breakdown is proposed. In point-contact diodes breakdown occurs earlier owing to the field effect.

621.382.2 **3179**

Field-Effect Pinch-Off of Surface Leakage in High-Voltage Diodes.—T. Kan. (*Solid-State Electronics*, Jan. 1961, Vol. 2, No. 1, pp. 68–69.) It is shown how reduced surface leakage and increased reverse-breakdown voltage can be achieved by proper geometry, so as to utilize the field-effect pinch-off.

621.382.22 **3180**

The Electrical Properties of Extensive Current Paths in Space-Charge Regions Close to the Surface of Semiconductors.—E. Groschwitz, E. Hofmeister & R. Ebhardt. (*Z. angew. Phys.*, Dec. 1960, Vol. 12, No. 12, pp. 544–557.) Theoretical treatment of surface currents in inversion layers, particularly relating to conditions in point-contact semiconductor diodes. See also 2799 of August.

621.382.23 **3181**

Construction and Characteristics of Silver-Bonded Diodes.—S. Kita. (*Rev. elect. Commun. Lab., Japan*, Jan./Feb. 1961, Vol. 9, Nos. 1/2, pp. 26–30.)

621.382.23 **3182**

High-Frequency Power in Tunnel Diodes.—G. Dermit. (*Proc. Inst. Radio Engrs*, June 1961, Vol. 49, No. 6, pp. 1033–1042.) An expression is developed for h.f. tunnel-diode power with a simple dissipative load and for signals confined within the nearly linear range of the diode negative resistance. Results are plotted for Ge and GaAs.

621.382.23 **3183**

The Equivalence Noise Current of Esaki Diodes.—R. A. Pucel. (*Proc. Inst. Radio Engrs*, June 1961, Vol. 49, No. 6, pp. 1080–1081.)

621.382.23 **3184**

Gallium Antimonide Esaki Diodes for High-Frequency Applications.—C. A. Burrus. (*Proc. Inst. Radio Engrs*, June 1961, Vol. 49, No. 6, p. 1101.) Diodes have been made, using both p- and n-type material, by methods similar to those applied for GaAs (*J. appl. Phys.*, June 1961, Vol. 32, No. 6, pp. 1031–1036). They have been tested as oscillators in the 50-Gc/s range.

621.382.23 : 621.372.44 **3185**

Some Effects of Material Parameters on the Design of Surface-Space-Charge Varactors.—D. R. Frankl. (*Solid-State Electronics*, Jan. 1961, Vol. 2, No. 1, pp. 71–76.) Theoretical discussion of the effects of material parameters (semiconductor and dielectric materials and layer thicknesses) on the capacitance variation and cut-off frequency of varactor diodes.

621.382.23 : 621.375.9 **3186**

A Millimetre-Wave Esaki-Diode Amplifier.—C. A. Burrus & R. Trambarulo. (*Proc. Inst. Radio Engrs*, June 1961, Vol. 49, No. 6, pp. 1075–1076.) Amplification with Esaki diodes has been achieved in the frequency range 55–85 Gc/s. Gain was 20 dB with 40 Mc/s bandwidth. Noise figure was 16–18 dB, mainly due to circuit losses.

621.382.3 : 621.317 **3187**

Transistors in Measurement Techniques: Properties and Application.—H. Schneider. (*Elektrotech. Z., Edn A*, 24th Oct. 1960, Vol. 81, No. 22, pp. 767–773.) Analysis of the properties and characteristics of transistors to assess their suitability for various measurement applications; the advantages and disadvantages in comparison with relays and thermionic valves are indicated.

621.382.3 : 621.318.57 **3188**

Storage Time of a Transistor with a Decaying Turn-Off Current.—D. M. Taub. (*Proc. Instn elect. Engrs*, Part B, May 1961, Vol. 108, No. 39, pp. 344–347.) A theoretical calculation of the storage time.

621.382.3.002.2 **3189**

Methods of Producing Stable Transistors.—J. J. A. Ploos van Amstel. (*Philips tech. Rev.*, 14th March 1961, Vol. 22, No. 6, pp. 204–214.) Very stable Ge transistors are produced by 'surface forming' at 140°C, with the transistor encapsulated in a mixture of silicone grease, boracic acid and arsenic.

621.383 **3190**

Photoelectric Cells and Photomultipliers.—J. Sharpe. (*Electronic Technol.*, June & July 1961, Vol. 38, Nos. 6 & 7, pp. 196–201 & 248–256.) A review of the properties and applications of photoemissive cells and photomultiplier tubes.

621.383.5 **3191**

The Influence of the Surface Recombination Velocity and the Absorption

Coefficient on the Transient Characteristics of Photodiodes.—A. A. Grinberg & N. B. Strokan. (*Fiz. Tverdogo Tela*, July 1960, Vol. 2, No. 7, pp. 1536–1541.)

621.385.032.213.23 **3192**

Emission of Negative Ions of Oxygen from Dispenser Cathodes: Parts 1 & 2.—N. A. Surplice. (*Brit. J. appl. Phys.*, May 1961, Vol. 12, No. 5, pp. 214–219 & 220–221.) *Report of experimental investigations of negative-ion emission from cathodes of BaO in sintered Ni and of sintered W impregnated with Ba aluminate.*

621.385.032.213.23 **3193**

The Emission Equation of the Oxide Cathode.—J. Ruf. (*Telefunken-Röhre*, Oct. 1960, No. 37, pp. 79–132.) Thermionic-emission theory is reviewed and emission equations relating to various models of oxide cathode are given. 46 references.

621.385.032.213.23 **3194**

The Evaluation of Oxide-Cathode Quality by Shot-Noise Tests.—J. G. Schuetzen. (*J. Brit. Instn Radio Engrs*, May 1961, Vol. 21, No. 5, pp. 465–467.) The shot-noise test appears to be more sensitive than other methods and does not affect the cathode. Simple test equipment is described. See also 4018 of 1958 (Dahlke & Dinsdy).

621.385.2 **3195**

The Effect of Elastically Reflected Electrons on the Characteristics of a Thermionic Diode.—K. H. V. Booth & I. A. Harris. (*Proc. roy. Soc. A*, 11th April 1961, Vol. 261, No. 1304, pp. 134–152.) The elastic reflection of slow electrons (< 2 eV) in a diode with an oxide-coated cathode has a major effect on the *I/V* characteristic and the electric field distribution.

621.385.3: 621.396.61 **3196**

Calculation of Optimum Operational Data of Transmitter Valves.—G. Schuster. (*Hochfrequenztech. u. Elektroakust.*, Aug. 1960, Vol. 69, No. 4, pp. 124–132.) Calculations and characteristic curves refer to the use of a power triode in induction heating equipment, but are of general application in determining optimum operating conditions.

621.385.3.029.6 **3197**

Applications of Microwave Triodes.—J. P. M. Gieles. (*Philips tech. Rev.*, 4th Nov. 1960, Vol. 22, No. 1, pp. 16–28.) A comprehensive survey of current practice in the commercial field.

621.385.6: 537.533.08 **3198**

Electron-Beam Analyser using a Piezoelectric Scanner.—T. Fujii. (*Rev. sci. Instrum.*, April 1961, Vol. 32, No. 4, pp. 434–444.) This instrument measures transverse current density distributions of high-density electron beams using a moving pinhole target driven by a pair of $BaTiO_3$ elements. Sampling can be carried out very close to the anode aperture of an electron gun.

621.385.6: 621.375.9: 621.372.44 **3199**

A Low-Noise Microwave Quadrupole Amplifier.—A. Ashkin. (*Proc. Inst. Radio Engrs*, June 1961, Vol. 49, No. 6, pp. 1016–1020.) The design of a quadrupole amplifier is discussed and experimental results using a frequency of 4 137 Mc/s are described. At a gain of 19 dB the measured double-channel noise figure is 0·79 dB.

621.385.62/.63: 621.391.832.4 **3200**

New Results on Frequency Multiplication and Nonlinear Phase Distortion in Klystrons and Travelling-Wave Tubes.—F. Paschke. (*RCA Rev.*, March 1961, Vol. 22, No. 1, pp. 162–184.) The nonlinear space-charge-wave equation is solved by third-order successive approximation. Phase delay and frequency multiplication effects agree well with experimental observations.

621.385.623.5 **3201**

Effect of Magnetic Fields upon Reflex-Klystron Characteristics.—M. E. Brodwin & J. W. Davis. (*Rev. sci. Instrum.*, Feb. 1961, Vol. 32, No. 2, pp. 223–224.) Experimental results show that magnetic control of frequency is as effective as repeller control, and that the controlling elements are independent of the klystron power supply. This system should be advantageous for the stabilization of high-voltage mm-wave klystrons.

621.385.63 **3202**

Power Carried by the Cyclotron Waves and the Synchronous Waves on a Filamentary Electron Beam.—S. Saito. (*Proc. Inst. Radio Engrs*, May 1961, Vol. 49, No. 5, Part 1, pp. 969–970.)

621.385.63: 621.373.423 **3203**

An Electrically Tunable Microwave Oscillator with High Efficiency and a Constant Output Level Independent of Frequency.—W. Eichin & H. Heynisch. (*Nachrichtentech. Z.*, Oct. 1960, Vol. 13, No. 10, pp. 457–461.) The oscillator described consists of a combination of a backward-wave oscillator with a travelling-wave amplifier system in the same envelope and coupled by a common electron beam. The efficiency obtainable is that of a travelling-wave tube. Experimental results are given which were obtained with modified travelling-wave tubes containing a section of interdigital line or an eccentrically arranged helix, operating in the 4–6-Gc/s region.

621.385.63: 621.375.9: 621.372.44 **3204**

Excitation and Amplification of Cyclotron Waves and Thermal Orbits in the Presence of Space Charge.—R. Adler, A. Ashkin & E. I. Gordon. (*J. appl. Phys.*, April 1961, Vol. 32, No. 4, pp. 672–675.) The effect of space charge on the motion of an electron beam and its individual electrons in the transverse fields of cyclotron-wave amplifiers is considered. The effect is such that low-field quadrupolar amplifiers do not saturate at low gains.

621.385.63: 621.375.9: 621.372.44 **3205**

Travelling-Wave Analysis of a Class of Parametric Amplifiers Based upon the Hill Equation.—R. W. Fredricks. (*J. appl. Phys.*, May 1961, Vol. 32, No. 5, pp. 901–904.) Formulae are deduced for the complex wave number of beams, and conditions for growing-wave solutions are presented. The case of a sinusoidal pump field variation is treated, the optimum condition obtains when the pump frequency is twice the beam natural frequency.

621.385.632: 621.391.822 **3206**

Noise Smoothing by Reactive Damping in Finite Multivelocity Electron Beams.—J. Berghammer. (*RCA Rev.*, March 1961, Vol. 22, No. 1, pp. 185–198.) In an electron beam with rectangular velocity distribution a pair of exactly damped waves exist in addition to the Hahn-Ramo waves. Noise smoothing can result in long low-velocity beams of high density.

621.385.632.12 **3207**

Propagation of E.M. Waves along a Helix.—E. Dingsdley & A. Cunliffe. (*Electronic Technol.*, July 1961, Vol. 38, No. 7, pp. 262–266.) The introduction of an inner conductor along the axis of a helix to provide e.s. focusing in a travelling-wave tube is considered. The inner conductor allows both slow and fast waves to be propagated corresponding respectively to the wave propagated along the helix and the conductor. Each is modified by the presence of the other. Experimental data are discussed.

621.385.69: 621.372.2 **3208**

Distributed Amplifier Tube.—T. Kojima. (*Rec. elect. Commun. Lab., Japan*, July-Aug. 1960, Vol. 8, Nos. 7/8, pp. 343–360.) The anode and grid are helical lines with a common velocity of propagation for e.m. waves. Theory of amplification and measured characteristics are given for two experimental tubes, one of which has an operating range 0–150 Mc/s. See 1081 of 1960.

621.385.832 **3209**

Dynamic Deflection Sensitivity of Inclined Deflection Plates.—E. Gundert. (*Telefunken-Röhre*, Oct. 1960, No. 37, pp. 5–16.) The deflection angle of an electron beam at the end of inclined deflection plates is calculated for frequencies at which electron transit time is no longer negligible with respect to the period of the deflection voltage. The plate length for the largest deflection angle is also calculated.

621.385.832: 681.142 **3210**

Design of a High-Resolution Electrostatic Cathode-Ray Tube for the Flying-Spot Store.—H. G. Cooper. (*Bell Syst. Tech. J.*, May 1961, Vol. 40, No. 3, pp. 723–759.) The design is discussed in relation to optimum gun performance and minimum deflection focusing. A substantial reduction is effected in beam aberrations due to fringing of the deflection fields.

621.387: 621.362 **3211**

Calculation of the Maximum Efficiency of the Thermionic Converter.—J. H. Ingold. (*J. appl. Phys.*, May 1961, Vol. 32, No. 5, pp. 769–772.)

621.387: 621.362 **3212**

Oscillations and Saturation-Current Measurements in Thermionic Conversion Cells.—Zollweg & Gottlieb. (See 3122.)

Abstracts and References

COMPILED BY THE RADIO RESEARCH ORGANIZATION OF THE DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH AND PUBLISHED BY ARRANGEMENT WITH THAT DEPARTMENT

The abstracts are classified in accordance with the Universal Decimal Classification. They are arranged within broad subject sections in the order of the U.D.C. numbers, except that notices of book reviews are placed at the ends of the sections. U.D.C. numbers marked with a dagger (†) must be regarded as provisional. The abbreviations of journal titles conform generally with the style of the World List of Scientific Periodicals. An Author and Subject Index to the abstracts is published annually. It includes a list of journals abstracted, the abbreviations of their titles and their publishers' addresses. Copies of articles in journals referred to are not available from Electronic Technology. *Application must be made to the individual publishers concerned.*

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ACOUSTICS AND AUDIO FREQUENCIES

534.121.1-8 **3213**

Experimental Confirmation of Lamb Waves at Megacycle Frequencies.—D. C. Worlton. (*J. appl. Phys.*, June 1961, Vol. 32, No. 6, pp. 967–971.) Confirmation of a theory formulated in 1916 by Horace Lamb predicting that plates may vibrate in an infinite number of modes.

534.2 + 538.566 **3214**

Wave Propagation in an Inhomogeneous Waveguide.—Brekhovskikh & Eliseevnin. (See 3339.)

534.2 **3215**

Nonlinear Effects in some Acoustic Problems.—M. A. Isakovich. (*Akust. Zh.*, 1960, Vol. 6, No. 3, pp. 321–325.) In contrast to the case of propagation in an unbounded space, the secular terms are missing in the solution for waveguide propagation, with the exception of degenerate cases. The absence of secular terms is dependent on dispersion.

534.2-8 **3216**

Finite-Amplitude Ultrasonic Wave Propagation in Relaxing Media.—A. L. Polyakova. (*Akust. Zh.*, 1960, Vol. 6, No. 3, pp. 356–359.) If the sound amplitude is less than the value characterizing the dispersion and relaxation absorption, the second-harmonic content is determined basically by the absorption.

534.232 **3217**

Maximum-Power Criterion for the Vibrating Free-Edge Disk.—R. N. House, Jr. (*J. acoust. Soc. Amer.*, May 1961, Vol. 33, No. 5, pp. 564–565.) A method of determining safe power levels for piezoelectrically driven flexural-mode transducers has been developed.

534.232 **3218**

On Correlating the Loss Factors of Cylindrical and Spherical Resonators.—P. D. Edmonds. (*J. acoust. Soc. Amer.*, May 1961, Vol. 33, No. 5, pp. 615–622.)

534.232: 538.652 **3219**

Magnetostrictive Ferrites as Materials for Electroacoustic Transducers.—I. P. Golyamina. (*Akust. Zh.*, 1960, Vol. 6, No. 3, pp. 311–320.) Investigation of Ni, Ni-Zn and Ni-Co ferrites shows that their magnetostrictive properties are comparable in magnitude with the corresponding parameters of more generally used metals.

534.232-8 **3220**

Coupling of Ultrasonic Resonators to Self-Excited Single-Stage High-Frequency Generators.—W. Steglich. (*Nachr.-Tech.*, Oct. 1960, Vol. 10, No. 10, pp. 446–449.) The coupling of piezoelectric and magnetostrictive resonators to an oscillator circuit is discussed, with examples.

534.26-14 **3221**

Experimental Study of the Scattering of Acoustic Energy from Solid Metal Spheres in Water.—L. D. Hampton & C. M. McKinney. (*J. acoust. Soc. Amer.*, May 1961, Vol. 33, No. 5, pp. 664–673.) The spheres cannot be counted as rigid bodies as appreciable energy penetrates the surface, which causes a complicated echo pattern to be returned. The acoustic energy distribution for spheres of diameter 5 in. and 7 in. is illustrated.

534.417 **3222**

Factors that Determine the Equivalent Noise Pressure, Free-Field Voltage Response, and Efficiency of a Transducer at Low Frequencies.—P. M. Kendig. (*J. acoust. Soc. Amer.*, May 1961, Vol. 33, No. 5, pp. 674–676.) A well designed hydrophone should have an equivalent noise pressure well below zero sea-state ambient. The equivalent noise pressure or efficiency of a transducer gives an essential indication of ability to measure low-level signals, but the free-field voltage response does not.

534.75: 534.32 **3223**

What do we Sense as Uniform Noise?—L. Schreiber. (*Frequenz*, Dec. 1960, Vol. 14, No. 12, pp. 399–403.) Theoretical consideration of Dirac-type noise and the minimum pulse frequency at which a succession of pulses is heard as uniform noise. The results of subjective tests are given and discussed, in which the effect of varying the parameters of an inserted low-pass filter are also investigated.

534.78 **3224**

Liveness Effects on the Intelligibility of Noise-Masked Speech.—P. O. Thompson, J. C. Webster & R. S. Gales. (*J. acoust. Soc. Amer.*, May 1961, Vol. 33, No. 5, pp.

604–605.) Speech is more intelligible against a noise background when the reverberant components associated with 'liveness' are not present.

534.78: 621.391 **3225**

Bandwidth Compression of Speech.—J. Das. (*Electronic Technol.*, Aug. 1961, Vol. 38, No. 8, pp. 298–300.) A method of reducing the bandwidth of time-varying signals by sampling in the frequency domain alone is discussed. Intelligible signals can be obtained even with large bandwidth compression.

534.793 **3226**

The Development of a Level-Distribution Meter for the Assessment of Audibility in Rooms.—H. Niese. (*Nachr-Tech.*, Nov. 1960, Vol. 10, No. 11, pp. 487–494.) The equipment described uses a source of periodic pulses and a stereophonic microphone; the sound level distribution in a lecture hall has been measured and results are illustrated.

534.8-8: 539.32.08 **3227**

Notes and References for the Measurement of Elastic Moduli by Means of Ultrasonic Waves.—H. J. McSkimin. (*J. acoust. Soc. Amer.*, May 1961, Vol. 33, No. 5, pp. 606–615.) Aspects of wave propagation applicable to the measurement of elastic moduli of solids are reviewed. Experimental techniques and factors affecting accuracy are discussed. 111 references.

534.83 **3228**

The Effect of Open Acoustic Screens in Interior Rooms.—H. Börner. (*Hochfrequenztech. u. Elektroakust.*, Dec. 1960, Vol. 69, No. 6, pp. 221–225.) The effectiveness of noise-reducing screens is calculated; experimental results are also given.

534.846 **3229**

Recent Applications of Acoustical Engineering Principles in Studio and Review Rooms.—W. B. Snow. (*J. Soc. Mot. Pict. Telev. Engrs*, Jan. 1961, Vol. 70, No. 1, pp. 33–38.)

534.861 **3230**

Statistical Properties of a Radio Broadcast Signal.—A. V. Rimskil-Korsakov. (*Akust. Zh.*, 1960, Vol. 6, No. 3, pp. 360–369.) Analysis of experimental results obtained by various authors relating to the distribution of instantaneous values and of the dynamic levels of broadcast music and speech.

534.88 **3231**

Measuring the Transverse Correlation Coefficient of a Continuous Acoustic Signal in the Sea.—S. G. Gershman & Yu. I. Tuzhilkin. (*Akust. Zh.*, 1960, Vol. 6, No. 3, pp. 292–298.) Investigation showed that at a frequency of 7·5 ± 0·2 kc/s, for distances between the wave front and the source of up to 12 km, and for a spacing of receivers along the wave front of up to 3 km, the correlation coefficient had a value close to unity.

534.88 **3232**

Effect of an Internal Wave on Sound in the Ocean.—O. S. Lee. (*J. acoust. Soc. Amer.*, May 1961, Vol. 33, No. 5, pp. 677–681.) A comparison of computed sound fields with, and without, an oscillation of the thermoclines for an ideal ocean medium with three distinct layers. Intensity changes of as much as 22 dB may occur over one internal wavelength.

621.395.61 **3233**

The Insensitivity to Noise of Gradient Microphones of First and Higher Order.—K. Feik & G. Kaszynski. (*Hochfrequenztech. u. Elektroakust.*, Dec. 1960, Vol. 69, No. 6, pp. 201–211.) Theoretical and experimental investigation of first- and second-order gradient microphones.

621.395.61: 681.84 **3234**

Guidance on the Microphone Distance in Sound Recordings.—E. Briner-Aimo. (*Tech. Mitt. PTT.*, Jan. 1961, Vol. 39, No. 1, pp. 5–20.) Aspects of sound field distribution and reverberation effects, which are important to the sound recording engineer, are summarized.

621.395.623.7 **3235**

Electrodynamic Loudspeaker has Totally Active Surface.—S. R. Rich. (*Electronics*, 16th June 1961, Vol. 34, No. 24, pp. 49–51.) A system giving excellent response over the whole a.f. range is described. It consists of a nonresonant, pneumatically loaded bass unit and a current-carrying sheet within a magnetic field as a treble unit. High-frequency performance is improved by a thin corrugated Al diaphragm as a secondary radiator, mounted near the driver coil of the treble unit.

621.395.625.3: 538.221 **3236**

Magnetic Recording.—Sebestyen & Takacs. (See 3493.)

AERIALS AND TRANSMISSION LINES

621.315.212 **3237**

A Liquid-Helium-Cooled Coaxial Termination.—C. T. Stelzried. (*Proc. Inst. Radio Engrs*, July 1961, Vol. 49, No. 7, p. 1224.) This unit is useful for low-noise calibrations.

621.372.823 **3238**

The Effect of Guide Irregularities on the Transmission of TE$_{01}$ Waves.—M. Jouguet. (*Câbles & Transm.*, Jan. 1961, Vol. 15, No. 1, pp. 3–26.) An examination of the parasitic waves generated in waveguides including estimates of their amplitude and power. Numerical results are given for a circular waveguide of diameter 50 mm operated at 35 Gc/s. See also 2080 of July.

621.372.824 **3239**

The Suppression of Parasitic Gap Resonances on Noncontacting Short-Circuiting Plungers for Coaxial Resonant Circuits.—W. Spindler. (*Arch. elekt. Übertragung*, Dec. 1960, Vol. 14, No. 12, pp. 554–560.) An exact equivalent circuit is derived for the plunger gap with slots [see 644 of 1948 (Huggins)]. New types of pattern are described which provide greater mechanical stability and a wider useful band for the coaxial resonator.

621.372.824: 621.316.8 **3240**

A Precision Coaxial Termination Resistor.—C. Stäger. (*Tech. Mitt. PTT*, Jan. 1961, Vol. 39, No. 1, pp. 25–28.) The design of a 50-Ω reflectionless termination for use in the frequency range 1–9 Gc/s is described.

621.372.829 **3241**

TM Modes in Parallelogrammic Waveguides.—R. J. Doviak, D. J. Lewis & P. P. Lombardini. (*Proc. Inst. Radio Engrs*, July 1961, Vol. 49, No. 7, p. 1222.) TM modes can exist in parallelogrammic waveguides and an approximate formula for f_c is given.

621.372.832.4 **3242**

A Variable Microwave Power Divider.—D. Milanovic. (*Onde élect.*, Feb. 1961, Vol. 41, No. 407, pp. 180–183.) A practical form of power divider is described using directional coupling between two waveguides and the Faraday effect in a ferrite rod.

621.372.832.43 **3243**

The Use of Asymmetric Coupling for Waveguide Directional Couplers with Frequency-Independent Coupling Factor.—W. Nowak. (*Hochfrequenztech. u. Elektroakust.*, Oct. 1960, Vol. 69, No. 5, pp. 179–188.) The asymmetric H_z-H_z multi-aperture coupler described has a flat frequency response and is suitable for coupling factors of the order of 3–20 dB.

621.372.832.43 **3244**

The Oblique-Slot Coupler, a New Waveguide Directional Coupler for Frequency-Independent Loose Couplings.—W. Nowak. (*Hochfrequenztech. u. Elektroakust.*, Dec. 1960, Vol. 69, No. 6, pp. 193–201.) The coupler described is suitable for coupling factors of about 10–60 dB. An arrangement for closer coupling is described in 3243 above.

621.372.837: 621.382.23 **3245**

Semiconductor-Diode Waveguide Switch.—T. H. B. Baker. (*Electronic Technol.*, Aug. 1961, Vol. 38, No. 8, pp. 300–304.) The relation of the switching ratio, bandwidth and power handling capabilities to diode and transmission-line parameters is given.

621.372.852.2 **3246**

Reciprocal and Nonreciprocal Phase Shifters in Rectangular Waveguide.—E. Pivit. (*Frequenz*, Nov. 1960, Vol. 14, No. 11, pp. 369–378.) Theoretical and experimental investigation of the dielectrically loaded waveguide as reciprocal phase shifter. Experimental results of measurements on ferrite-loaded nonreciprocal phase shifters are discussed, with particular reference to the temperature compensation of phase shift.

621.372.852.325: 538.632 **3247**

Microwave Isolator combines Hall Effect and Tunnel Diodes.—C. H. Hubbard, L. A. Losasso & E. Rosen.

(*Electronics*, 16th June 1961, Vol. 34, No. 24, pp. 56–57.) A simple circuit is described giving useful isolation up to about 30 Mc/s, and performance parameters are discussed. The InSb Hall-effect plate is provided with a thermoelectric cooler to provide additional circuit adjustment. Tunnel-diode lead inductance limits its performance.

621.396.67 **3248**

Some Problems regarding Medium-Wave Broadcast Aerials with Cross-Section Gradually Increasing towards the Centre (Fish-Belly Aerials).—N. Stanulov. (*Hochfrequenztech. u. Elektroakust.*, Oct. 1960, Vol. 69, No. 5, pp. 161–170.) Determination of the current distribution along this type of aerial and of its vertical radiation characteristics. Methods of improving the antifading properties are suggested.

621.396.67: 621.318.134 **3249**

A Nondirectional Ferrite Rod Antenna Arrangement Suitable for A.M. Radios.—O. K. Nilssen. (*Proc. Inst. Radio Engrs*, July 1961, Vol. 49, No. 7, pp. 1222–1223.) Signals from orthogonal ferrite rod aerials are added in quadrature.

621.396.67: 621.396.669 **3250**

The Suppression of Corona- and Precipitation-Interference in V.H.F. Reception.—Page. (See 3531.)

621.396.67.012.12 **3251**

A Method for the Synthesis of Radiation Patterns at Finite Distances.—L. Caprioli, L. Ronchi, A. Scheggi & G. Toraldo di Francia. (*Alta Frequenza*, Dec. 1960, Vol. 29, No. 6, pp. 653–666.) A semi-empirical procedure is described for an approximate synthesis using a finite number of spherical waves.

621.396.673 **3252**

The Behaviour of Linear Short and Thin Aerials with a Variation in Current Distribution.—G. D'Auria & F. Todero. (*Alta Frequenza*, Jan. 1961, Vol. 30, No. 1, pp. 28–42.) The effect of top loading on aerial performance is investigated. Expressions are derived for input impedance and radiation efficiency as a function of current distribution.

621.396.677.85 **3253**

Dielectric Lenses and Reflectors made from Homogenous Spherical Layers.—P. M. Prache. (*Ann. Télécommun.*, March/April 1961, Vol. 16, Nos. 3/4, pp. 85–95.) A method which is given for calculating the ray paths in manufactured lenses and reflectors is also used to determine the equivalent surface of a reflector as a function of the angle between the incident and reflected rays. Theoretical results are in good agreement with results of measurements on a reflector of diameter 175 mm.

621.396.679 **3254**

The Achievement of Optimum Vertical Field Strength at the Ground by means of Wire Grids.—K. Bust. (*Elektrotech. Z., Ed. A*, 2nd Jan. 1961, Vol. 82, No. 1, pp. 13–18.) The effect of a.c. reflection at the foot of receiving aerials is considered, and details are given of the design of wire grids for producing a maximum of the interference field strength at ground level.

AUTOMATIC COMPUTERS

681.142 **3255**

Design and Application of a Digital Differential Analyser.—D. Lamb. (*Proc. Instn Radio Engrs, Aust.*, April 1961, Vol. 22, No. 4, pp. 243–249.) The principles of operation and limitations of a digital incremental computer are given and fields of research in which its accuracy and speed would be useful are suggested.

681.142 **3256**

Full Binary Adder with One Tunnel Diode.—B. Rabinovici & C. A. Renton. (*Proc. Inst. Radio Engrs*, July 1961, Vol. 49, No. 7, pp. 1213–1214.) Three resistors and one tunnel diode in a Wheatstone bridge network give both 'sum' and 'carry' outputs.

681.142: 512.3 **3257**

A Program for finding the Zeros of a Polynomial by Analogue Computer.—A. Lepschy. (*Alta Frequenza*, Jan. 1961, Vol. 30, No. 1, pp. 21–27.)

681.142: 621.318.134 **3258**

A Magnetic Associative Memory.—J. R. Kiseda, H. E. Petersen, W. C. Seelbach & M. Teig. (*IBM J. Res. Developm.*, April 1961, Vol. 5, No. 2, pp. 106–121.) A computer storage system is described in which data flow in and out on the basis of content rather than location. A small experimental model of the system using ferrite cores is also described.

681.142: 621.319 **3259**

A Probability Distribution Analyser utilizing Electrostatic Storage.—I. K. Harvey. (*Electronic Engng*, July 1961, Vol. 33, No. 401, pp. 432–436.) The instrument has a linearity within ± 0·25% and analyses input waveforms of frequency 0–20 kc/s.

681.142: 621.372.54: 621.391 **3260**

A Universal Nonlinear Filter, Predictor and Simulator which Optimizes itself by a Learning Process.—D. Gabor, W. P. L. Wilby & R. Woodcock. (*Proc. Instn elect. Engrs*, Part B, July 1961, Vol. 108, No. 40, pp. 422–435. Discussion, pp. 436–438.) After a discussion of some cybernetic principles a machine is described which, by a process of successive runs on an input function, ultimately produces a target function with least error. The machine incorporates a 20-track tape recorder, and 80 analogue multipliers of a novel piezomagnetic type which perform 1 000 multiplications per second with errors not exceeding 0·5%.

681.142: 621.385.832 **3261**

A Cathode-Ray-Tube Output for a Digital Computer.—R. L. Cervenka & M. Barrachough. (*J. Brit. Instn Radio Engrs*, June 1961, Vol. 21, No. 6, pp. 497–501.) A variety of displays can be programmed, and are photographed by a camera controlled by the computer.

681.142: 621.385.832 **3262**

Radar-Computer Display traces Alphanumeric Characters.—K. E. Perry & E. J. Aho. (*Electronics*, 30th June 1961, Vol. 34, No. 26, pp. 75–79.) The 64 available characters are displayed by the spot deflection method at a rate of 13 500/sec. A full description of the system with block and circuit diagrams is given.

681.142: 621.398 **3263**

Logarithmic Compression of Binary Numbers.—D. H. Schaeffer. (*Proc. Inst. Radio Engrs*, July 1961, Vol. 49, No. 7, p.1219.) This 19-to-8 bit converter uses 4 bits for the most significant figures and 4 bits to indicate the position of the binary point. Accuracy is within ± 3%.

CIRCUITS AND CIRCUIT ELEMENTS

621.3.049.7: 539.23 **3264**

Step-by-Step Design Techniques for Multilayer Thin-Film Networks.—W. N. Carroll & F. F. Jenny. (*Electronics*, 19th May 1961, Vol. 34, No. 20, pp. 90–93.) Performances of various circuits incorporating thin-film passive networks and those with conventional components are compared.

621.318.43: 621.396.962.33 **3265**

Magnetics in Doppler Signal Data Extraction.—R. J. Metz & J. G. Fay. (*Commun. & Electronics*, March 1961, No. 53, pp. 33–43.) Doppler radar data extraction problems such as detection, integration and interrogation using devices with magnetic cores are discussed.

621.318.57 **3266**

A Magnetic Device for High-Speed Sensing of Small Currents.—J. A. Baldwin, Jr. (*Commun. & Electronics*, March 1961, No. 53, pp. 1–3.) The structure and operation of the 'ferrod' device are described. It comprises a bar of low-coercive-force square-loop ferrite with two holes transverse to the long axis. The material around the holes acts as a pair of toroidal cores whose switchable flux may be controlled by a solenoid current.

621.319.4: 621.317.72 **3267**

The Vibrating Capacitor, Theory and Application.—Riegler. (See 3510.)

621.372.44 **3268**

The Energy Properties of Nonlinear Reactance Circuits.—J. Neirynck. (*Rec. HF, Brussels*, 1961, Vol. 5, No. 1, pp. 13–17.) There will be a conversion of power at one frequency to power at another frequency if one frequency is a rational fraction of the other or if at least one intermodulation frequency exists.

621.372.5 **3269**

A Network Theorem.—J. B. Rizzi. (*A.W.A. tech. Rev.*, Dec. 1960, Vol. 11,

No. 5, pp. 407–426.) The problem of determining the transfer impedance between a generator e.m.f. at one end of a resistance-terminated ladder network and the load current at the other end is simplified by splitting the circuit into two sections.

621.372.5 **3270**

On Scattering Matrices Normalized to Complex Port Numbers.—D. C. Youla. (*Proc. Inst. Radio Engrs*, July 1961, Vol. 49, No. 7, p. 1221.) A 2n-terminal network with generators having complex impedances is considered.

621.372.5: 517.98 **3271**

A Review of Methods of Linear Network Analysis in the Steady State: Parts 1 & 2.—P. W. Seymour. (*Proc. Instn Radio Engrs, Aust.*, Feb. & April 1961, Vol. 22, Nos. 2 & 4, pp. 77–86 & 253–270. Correction, *ibid.*, p. 249.) The establishment of an independent set of network variables permits various methods of network solution. The four-terminal network and the use of reference parameters are also considered.

621.372.51 **3272**

Wide-Band Impedance Transformers.—J. B. Rudd. (*A.W.A. tech. Rev.*, Dec. 1960, Vol. 11, No. 3, pp. 179–194.) An analysis of networks consisting of cascades of lumped-circuit λ/4 sections of graded impedance level.

621.372.54 **3273**

A Property of Passive Lossless Quadripoles and its Application in the Design of Ladder Filters.—Y. Peltier. (*Câbles & Transm.*, Jan. 1961, Vol. 15, No. 1, pp. 27–50.) The validity of formulae giving the values of elements of various filter structures is established by expressing the insertion loss as a function of the iterative parameters of a fictitious network.

621.372.54: 517.7 **3274**

Using Jacobians for Frequency-Selective Networks.—T. R. Nisbet & W. W. Happ. (*Electronic Ind.*, Jan. 1961, Vol. 20, No. 1, pp. 86–89.) The advantages of the use of Jacobians for synthesis of networks to give a specific frequency response is demonstrated with a simple network.

621.372.54: 534.143 **3275**

Computation of Mechanical Filters.—M. Borner. (*Elektronische Rundschau*, Jan. 1961, Vol. 15, No. 1, pp. 11–14.) Filter design procedure and data are summarized.

621.372.54: 621.372.57 **3276**

Active Low-Pass *RC* Filters.—D. P. Franklin. (*Electronic Technol.*, Aug. 1961, Vol. 38, No. 8, pp. 278–282.) A method is described of synthesizing the overall response of active cascaded low-pass filters using simple *RC* ladders and buffer amplification.

621.372.632: 621.382.23 **3277**

Tunnel-Diode Down-Converters.—D. G. Peterson. (*Proc. Inst. Radio Engrs*, July 1961, Vol. 49, No. 7, pp. 1225–1226.) Different circuit analyses are compared.

621.373: 621.372.44 **3278**

The Dynamics of a Subharmonic Oscillator with Linear Dissipation.—G. J. Lasher. (*IBM J. Res. Develpm.*, April 1961, Vol. 5, No. 2, pp. 157–161.) A mathematical analysis is made of the dynamic behaviour of subharmonic oscillators (parametrons) assuming a nonlinear reactance but a linear dissipation or resistance.

621.373 + 621.375].029.65 **3279**

Present State of Millimetre-Wave Generation and Amplification.—W. Veith. (*Nachrichtentech. Z.*, Dec. 1960, Vol. 13, No. 12, pp. 592–597.) A review of techniques particularly those based on the use of conventional microwave valves.

621.375.42.072.7 **3280**

Pull-in Frequency of the Phase-Controlled Oscillator.—A. J. Goldstein & C. J. Byrne. (*Proc. Inst. Radio Engrs*, July 1961, Vol. 49, No. 7, p. 1209.) The pull-in frequency derived by Goldstein and confirmed experimentally by Byrne is lower than that recently derived by Rey (*ibid.*, January).

621.373.422 **3281**

Additional Negative-Resistance Oscillation Modes.—W. N. Carr & T. C. Matty. (*Proc. Inst. Radio Engrs*, July 1961, Vol. 49, No. 7, p. 1225.) Several 'class-C' modes are considered.

621.373.43 **3282**

Voltage-Variable Capacitors make a Relaxation Oscillator.—J. Lopez & J. Brown. (*Electronics*, 19th May 1961, Vol. 34, No. 20, pp. 96–98.) The controllable frequency range is 15 c/s–1·5 kc/s.

621.374 **3283**

Random-Pulse Generator tests Circuits, encodes Messages.—B. K. Erickson & J. D. Schmidt. (*Electronics*, 23rd June 1961, Vol. 34, No. 25, pp. 56–59.) The shift-register generator uses high-speed logic circuits in producing complicated pulse sequences up to 4×10^9 bits in length.

621.374: 621.3.018.782 **3284**

Testing the Linear Distortion of Transmission Systems by means of Rectangular Pulses and Application of this Method for Explaining the Differential Equalization used in Magnetic-Tape Equipment.—H. Kumpfert. (*Frequenz*, Dec. 1960, Vol. 14, No. 12, pp. 416–421. Correction, *ibid.*, Jan. 1961, Vol. 15, No. 1, p. 31.)

621.374: 621.382.23 **3285**

Generation of Nanosecond Carrier Pulses at X Band with Tunnel Diodes.—L. U. Kibler. (*Proc. Inst. Radio Engrs*, July 1961, Vol. 49, No. 7, p. 1208.)

621.374.32: 621.382.23 **3286**

100-Mc/s Tunnel-Diode Ring Counter.—F. P. Heiman. (*Proc. Inst. Radio Engrs*, July 1961, Vol. 49, No. 7, p. 1215.)

621.374.32: 621.398 **3287**

Multiaperture-Core Counters give Nondestructive Storage Read-Out.—W. R. Johnston. (*Electronics*, 16th June 1961, Vol. 34, No. 24, pp. 62–64.) Description of a counter circuit and its use in a missile guidance control system.

621.374.33 **3288**

R.F. Gate with 19° Carrier Suppression.—R. J. Hume. (*Rev. sci. Instrum.*, May 1961, Vol. 32, No. 5, pp. 554–556.) A 10·7-Mc/s r.f. gate is described with a carrier suppression ratio > 100 dB. The ungated c.w. signal is continuously available. Circuitry, leakage measurements, and screening techniques are described.

621.374.4 **3289**

Frequency Multiplication by Large Factors by means of the Oscillation-Build-Up Method.—G. Becker. (*Frequenz*, Dec. 1960, Vol. 14, No. 12, pp. 442–446.) Frequency multiplication by factors of several thousands can be achieved with the oscillator described, which is pulse-controlled at the fundamental frequency and produces a harmonic spectrum of few components during the build-up of oscillations.

621.374.4: 529.786 **3290**

Methods of Pulse Selection to Produce Accurate Timing Marks from Standard Frequencies.—G. Becker. (*Arch. elekt. Übertragung*, Dec. 1960, Vol. 14, No. 12, pp. 539–542.) Counter circuits are given which are suitable for the production of low-frequency timing pulses independent of phase fluctuations in the frequency dividers of crystal clocks.

621.375: 512.83 **3291**

A Matrix Representation of Linear Amplifiers.—K. G. Nichols. (*J. Brit. Instn Radio Engrs*, June 1961, Vol. 21, No. 6, pp. 517–533.) Expressions are developed for the transfer matrices of combinations of bilateral and unilateral networks, and of some passive and active networks including feedback amplifiers.

621.375.049.7: 621.317.7 **3292**

Designing for Low-Level Inputs.—D. B. Schneider. (*Electronic Ind.*, Jan. 1961, Vol. 20, No. 1, pp. 81–85.) Difficulties arising in low-level input instrumentation, and methods of checking and evaluating the performance of such equipment are given.

621.375.121.1 **3293**

Interstage Design for Stagger-Loaded Amplifiers.—L. A. Beattie. (*Electronics*, 26th May 1961, Vol. 34, No. 21, pp. 60–63.) A family of low-pass Butterworth amplifiers, each stage having a different load impedance, is described. The resulting stagger-loaded amplifier has high gain and large bandwidth; an example shows half-power points at 2·7 Mc/s and 25 Mc/s and a mid-band gain of 95.

621.375.132 **3294**

The Theory of Negative-Feedback Voltage Amplifiers.—C. H. Vincent. (*Electronic Engng*, July 1961, Vol. 33, No. 401, pp. 442–444.) A modification of the standard method of analysis taking account of the fact that the attenuated feedback voltage cannot always be subtracted directly from the input voltage in practice.

621.375.2.024 **3295**

D.C. Amplifier with Particularly High Zero-Level Stability.—H. L. König. (*Arch. elekt. Übertragung*, Dec. 1960, Vol. 14, No. 12, pp. 563–573.) A push-pull circuit

for drift compensation in d.c. amplifiers is described and details are given of its practical application and performance.

621.375.223 2178

Contribution on the Dynamic Plate-Load Amplifier.—K. Enslen. (*Arch. elekt. Übertragung*, Nov. 1960, Vol. 14, No. 11, pp. 487–490.) A method is described for improving frequency and phase response of the type of amplifier considered in 2303 of 1959 (Brown).

621.375.9: 621.3.087.6 2217

Single-Ended Self-Balancing Magnetic Amplifiers for Changing the Effective Impedance of Ish Secondary.—W. A. Geyger. (*Commun. & Electronics*, March 1961, No. 53, pp. 8–13.)

621.375.4 2298

Common-Emitter Amplifier.—H. Lock. (*Electronic Technol.*, Aug. 1961, Vol. 38, No. 8, pp. 293–297.) The medium-frequency performance of common-emitter amplifiers is examined in terms of the simple equivalent circuit for a transistor. Formulae enabling the best type of transistor to be selected are derived.

621.375.4 2299

Transistor Cascade Circuit Improves Automatic Gain Control in Amplifiers.—J. F. Perkins, Jr. (*Electronics*, 2nd June 1961, Vol. 34, No. 22, pp. 49–51.) An improved method, with circuit details, for applying a.g.c. to transistor i.f. tuned amplifiers is described. The effects of changes in the transistor parameters, with change of operating point, on the Q-factor and the centre frequency of the tuned circuits are minimized.

621.375.4: 621.391.822 2300

A Theoretical Comparison of Average- and Spot-Noise Figure in Transistor Amplifiers.—J. A. Ekin & J. W. Halligan. (*Proc. Inst. Radio Engrs*, July 1961, Vol. 49, No. 7, pp. 1216–1217.)

621.375.9: 538.569.4 2301

Investigation of the Performance of Coupled-Cavity Maser-Type Amplifiers: Part 2.—G. Broussaud & L. Malnar. (*Onde élect.*, Feb. 1961, Vol. 41, No. 407, pp. 104–109.) A general formula is developed to determine the equivalent noise temperature and gain stability of several elementary structures. By comparing these results, interesting features of multicavity masers are demonstrated. Part 1: *ibid.*, Sept. 1960, Vol. 40, No. 402, pp. 555–572.

621.375.9: 538.569.4 2302

Travelling-Wave Maser with Instantaneous Bandwidths in Excess of 100 Mc/s.—S. Okwit & J. G. Smith. (*Proc. Inst. Radio Engrs*, July 1961, Vol. 49, No. 7, p. 1230.) Broad bandwidths, more than twice the intrinsic line-width of ruby, were obtained by stagger-tuning the applied external magnetic field.

621.375.9: 621.372.44 2303

Parametric Circuits with Nonlinear Reactances and Resistances.—K. H. Steiner. (*Arch. elekt. Übertragung*, Nov. 1960, Vol. 14, No. 11, pp. 482–486.) Equivalent circuits of nonlinear reactances and resistances are derived for calculations on parametric amplifiers. Expressions giving the circuit voltages are tabulated for parametric amplifiers, up-converters and down-converters of the dynatron type and the nonlinear-capacitance type.

621.375.9: 621.372.44 2304

Sensitivity of an Degenerate Parametric Amplifier.—J. T. de Jager & E. J. Robinson. (*Proc. Inst. Radio Engrs*, July 1961, Vol. 49, No. 7, pp. 1295–1296.) Although the noise temperature of a degenerate parametric amplifier is half that for a nondegenerate amplifier, the minimum detectable signal is only $\sqrt{2}$ better because the post-detector noise fluctuation increases by a $\sqrt{2}$ factor.

621.375.9: 621.372.44 2305

Noise Measure of Directional Negative-Conductance Amplifiers.—A. van der Ziel. (*Proc. Inst. Radio Engrs*, July 1961, Vol. 49, No. 7, pp. 1252–1253.) The modification required to the noise measure M for circuits in which the characteristic impedance has a reactive part, is given.

621.375.9: 621.372.44 2306

The Noise Temperature of Cascade-Connected Amplifiers.—W. Dahlke & H. Rieck. (*Telefunken-Röhre*, Dec. 1960, No. 30, pp. 37–60.) A formula is derived for the noise temperature of a cascade-connected amplifier with negative conductances as active elements. This permits a simple graphical representation of noise characteristics; examples are given of parametric-amplifier stages, and the influence of isolators and circulators on noise temperature and bandwidth is discussed.

621.375.9: 621.372.44 2307

Parametric Amplification with a Low-Frequency Pump.—G. F. Montgomery. (*Proc. Inst. Radio Engrs*, July 1961, Vol. 49, No. 7, pp. 1214–1215.) The degenerate form of a three-frequency parametric amplifier is considered.

621.375.9: 621.372.44 2308

An L-Band Travelling-Wave Parametric Amplifier.—S. J. Tetenbaum, F. A. Olsen & A. Sparavin. (*Proc. Inst. Radio Engrs*, July 1961, Vol. 49, No. 7, pp. 1230–1231.) A gain of 10 dB over a 10% band around 1·35 Gc/s has been achieved.

621.375.9: 621.372.44: 621.382.23 2309

Reactance Diodes and their Application in Wide-Band Waveguide Amplifiers.—Behrisch & Sandhaus. (See 2171.)

621.375.9: 621.372.44: 621.385.63 2310

Noise in Beam-Type Parametric Amplifiers.—Gordon. (See 2302.)

621.375.9: 621.372.44: 621.385.63 2311

Parametric Coupling between the Transverse Waves on O- and M-Type Beams.—Klinov. (See 2355.)

621.375.9: 621.372.44: 621.385.63 2312

Transduction of Noise. Theory of a Generalized Travelling-Wave Coupler.—Pease. (See 2336.)

621.375.9: 621.382.23 2313

Selective High-Frequency Amplification with Tunnel Diodes.—K. H. Müller. (*Elektronik*, Feb. 1961, Vol. 10, No. 2, pp. 39–43.) The design of a v.h.f. t.r.c. tuner using tunnel diodes is detailed.

621.375.9: 621.382.23 2314

Minimum Noise Figure of the Negative-Resistance Amplifier using Esaki Diodes.—M. Müller. (*Arch. elekt. Übertragung*, Nov. 1960, Vol. 14, No. 11, pp. 491–502.) The minimum noise figure is determined for a unneutralized single-stage amplifier, and the result is extended to cover multistage amplifiers. A noise figure of about 3 dB can be achieved for high-gain single-stage or multistage amplifiers.

621.375.9: 621.382.23 2315

Semiconductor Diode Circuit Possessing Gain.—S. Ritterman. (*Electronics*, 2nd June 1961, Vol. 34, No. 22, pp. 60–62.) The forward-reverse characteristics of a diode can be used to provide amplification (see 982 of 1955). The characteristics of a circuit operating with power-supply frequency considerably higher than the signal frequency are noted.

621.375.9: 621.382.23 2316

Noise Measure of Lossy Tunnel-Diode Amplifier Stages.—A. van der Ziel. (*Proc. Inst. Radio Engrs*, July 1961, Vol. 49, No. 7, pp. 1211–1212.) The influence of circuit losses and the diode series reactance on the noise figure of tunnel-diode amplifiers is considered. The calculation is repeated for a stable parallel circuit.

621.376.2: 621.318.435 2317

A Saturable-Core Modulation Integrator.—R. C. Barker & A. J. Grundle. (*Commun. & Electronics*, March 1961, No. 53, pp. 13–17.) A circuit is discussed which illustrates the use of saturable-core reactors for operating directly on a modulation carrier. Use is made of the ability of a saturable reactor to convert a voltage integral to a magnetic flux and store it until required.

621.376.223 2318

Constant-Resistance Modulators.—D. G. Tucker. (*J. Brit. Instn Radio Engrs*, June 1961, Vol. 21, No. 6, pp. 491–496.) Zobel's constant-resistance networks are interpreted in terms of constancy with time, when the elements of the network are time-variable, and simultaneously in the same network the original conception of constancy with frequency, when the elements are frequency-variable, may be realized. The application to rectifier modulators is examined.

621.376.23 2319

Requirements regarding Electrical Squaring Circuits and Practical Possibilities for the Realization of Square-Law Characteristics.—E. Sonntag. (*Hoch-frequenztech. u. Elektroakust.*, Dec. 1960, Vol. 69, No. 6, pp. 211–216.) The design of square-law detector circuits for use in the measurement of r.m.s. values is discussed and the characteristics of various types of circuit using diodes or amplifier valves are examined.

621.376.23 **3320**

Squaring Circuits with Staggered Diodes.—E. Sonntag. (*Hochfrequenztech. u. Elektroakust.*, Dec. 1960, Vol. 69, No. 6, pp. 217–221.) With the circuit described a square-law characteristic can be synthethized over a range of about 30 dB. Ge diodes give better results than those obtained with thermionic valves. See also 3319 above.

621.376.233.029.65 **3321**

Crystal Biasing Improves Millimetre-Wave Detector.—K. Iddi & A. L. Brault. (*Electronics*, 16th June 1961, Vol. 34, No. 24, p. 95.) At 73 Gc/s a 14-dB improvement in noise figure could be obtained by suitable biasing.

GENERAL PHYSICS

537.311.1 **3322**

Variational Method for Transport Parameters in Electron Conductors.—R. Klein. (*Z. Naturf.*, Jan. 1961, Vol. 16a, No. 1, pp. 116–121.) The method described results in a simplification and clarification of calculation procedure.

537.311.1 **3323**

Derivation of the Boltzmann Transport Equation for Inelastic Collisions.—P. N. Argyres. (*J. Phys. Chem. Solids*, April 1961, Vol. 19, Nos. 1/2, pp. 66–72.) A quantum-mechanical treatment similar to that developed by Kohn & Luttinger for elastic collisions (1105 of 1958). For Fermi-Dirac particles the scattering in the collision term of the transport equation is restricted to unoccupied states only.

537.311.33 **3324**

Negative Resistance and Hot Electrons.—I. Adawi. (*J. appl. Phys.*, June 1961, Vol. 32, No. 6, pp. 1101–1111.) *I/V* characteristics of hot electrons are analysed for negative-resistance regions. Electrons in a homogeneous semiconductor are assumed to interact only with acoustic phonons and charged centres of heavy mass which could be ionized impurities or heavy holes.

537.52 : 537.533.8 **3325**

Electron Bunching in the Multipacting Mechanism of High-Frequency Discharge.—A. J. Hatch. (*J. appl. Phys.*, June 1961, Vol. 32, No. 6, pp. 1086–1092.) Electron bunching is analysed by an extension of simple multipacting theory.

537.525 **3326**

Electronic and Ionic Current at the Cathode of a Hollow-Cathode Discharge.—V. K. Rohatgi. (*J. appl. Phys.*, June 1961, Vol. 32, No. 6, pp. 1173–1174.) The fractions of electronic and ionic current densities in the discharge are estimated. The possibilities of other electron-emission mechanisms are discussed.

537.56 **3327**

Instability of a Plasma with an Anisotropic Distribution of Ion and Electron Velocities.—A. V. Kitsenko & K. N. Stepanov. (*Zh. eksp. teor. Fiz.*, June 1960, Vol. 38, No. 6, pp. 1840–1846.) Investigation of the propagation of magnetohydrodynamic waves in an infinite rarefied plasma. A kinetic treatment leads to an increase of the instability region compared to that obtained in the quasihydrodynamic approximation.

537.56 **3328**

Fluctuations in a Multicomponent Plasma.—O. Buneman. (*J. geophys. Res.*, June 1961, Vol. 66, No. 6, pp. 1978–1979.) A theory of fluctuations in a plasma consisting of electrons and one kind of ion (3391 below) is generalized to apply to several species of ions.

537.56 : 534.1 **3329**

Electrostatic Sound Wave Modes in a Plasma.—F. W. Crawford. (*Phys. Rev. Lett.*, 15th June 1961, Vol. 6, No. 12, pp. 663–665.) The ratios between the frequencies of the peaks observed in the anode voltage fluctuations in Hg discharge tubes agree with those calculated using a simple theory of radial modes.

537.56 : 538.56 **3330**

Coupling Mechanisms between Longitudinal and Transverse Waves in a Plasma.—G. Burkhardt, C. Fahl & R. W. Larenz. (*Z. Phys.*, 27th Jan. 1961, Vol. 161, No. 4, pp. 380–387.) The possible coupling mechanisms are deduced on the basis of fundamental plasma equations. The existence of a nonlinear "internal coupling" effect is proved which can cause e.m. radiation.

537.56 : 538.56 **3331**

Enhanced Diffusion and Oscillations in Weakly Ionized Plasmas.—J. F. Bonnal, G. Briffod and C. Manus. (*Phys. Rev. Lett.*, 15th June 1961, Vol. 6, No. 12, pp. 665–667.)

538.3 **3332**

Average Forces in Electromagnetic Systems.—W. E. Smith. (*Aust. J. Phys.*, March 1961, Vol. 14, No. 1, pp. 152–159.) For a linear and loss-free system, it is shown that the time-average force can be expressed in directly measurable circuit-theory parameters.

538.56 **3333**

A Supplement to a Study of Electromagnetic Point Sources.—M. Bouix. (*Ann. Télécommun.*, March/April 1961, Vol. 16, Nos. 3/4, pp. 105–107.) A supplement to a previously published paper (*ibid.*, May/June 1959, Vol. 14, Nos. 5/6, pp. 143–150) establishing that there are only two fundamental fields which can effectively be replaced by a point source, corresponding to a distribution concentric about its origin.

538.561 : 537.122 **3334**

Cherenkov Radiation for a Dipole Moment in a Medium with Spatial Dispersion.—G. A. Begiashvili & É. V. Gedalin. (*Zh. eksp. teor Fiz.*, June 1960, Vol. 38, No. 6, pp. 1738–1739.) Treatment of electric and magnetic dipoles in an isotropic nongyrotropic medium. Radiation from a ring-current in such a medium is also considered.

538.561 : 537.56 **3335**

Radiation by Charged Particles passing through an Electron Plasma in an External Magnetic Field.—S. K. Majumdar. (*Proc. phys. Soc.*, 1st June 1961, Vol. 77, No. 498, pp. 1109–1120.) Coupling between the longitudinal plasma wave and the transverse e.m. wave modifies the nature of the radiation. At particle velocities greater than that required for the excitation of plasma waves, a non-Cherenkov type of radiation will occur.

538.561 : 537.56 **3336**

Incoherent Microwave Radiation from a Plasma in a Magnetic Field.—J. L. Hirshfield & S. C. Brown. (*Phys. Rev.*, 1st May 1961, Vol. 122, No. 3, pp. 719–725.) "The microwave emission from a plasma in a magnetic field is calculated theoretically using Kirchhoff's radiation law for cases when characteristic waves do not couple within the plasma. Experimental observations of radiation temperature and cyclotron radiation line breadth and shape are cited to illustrate applications of the theory to experiment."

538.564 : 539.12 **3337**

Classical Electrodynamic Equations of Motion with Radiative Reaction.—G. N. Plass. (*Rev. mod. Phys.*, Jan. 1961, Vol. 33, No. 1, pp. 37–62.) The classical theory is reviewed: previous objections to it are shown to be largely invalid.

538.561 : 539.12 **3338**

Radiation from Fast Particles Moving through Magnetic Materials.—T. B. Day. (*Phys. Rev.*, 15th May 1961, Vol. 122, No. 4, pp. 1028–1036.) Under certain conditions of frequency and angle of observation 'ringing' of the spin system occurs. Differences from the normal Cherenkov effect are discussed, also the possibility of using the effect as a neutral-magnetic-moment detector or as a probe of magnetic materials.

538.566 + 534.2 **3339**

Wave Propagation in an Inhomogeneous Waveguide.—M. M. Brekhovskikh & V. A. Eliseevnin. (*Akust. Zh.*, 1960, Vol. 6, No. 3, pp. 284–291.) Analysis of the propagation of acoustic waves in a waveguide whose properties vary along its length. The theory developed is applied to the propagation of acoustic and e.m. waves in natural waveguides which may extend to distances of 1 000 km and more.

538.566 **3340**

Study of the Electromagnetic Field produced by a Magnetic Doublet in the Presence of Two Media Separated by a Plane Surface.—L. Robin. (*Ann. Télécommun.*, March/April 1961, Vol. 16, Nos. 3/4, pp. 96–104.) A rigorous treatment for the general case of a doublet with its axis at any angle to the surface between the media. The effects of special media are also considered.

538.566 : [535.312 + 535.34 **3341**

The Reflection of Electromagnetic Waves at a Plane Metal Surface Covered with an Absorbing Layer.—R. Unbehauen & H. J. Hoffman. (*Arch. elekt. Übertragung*, Dec. 1960, Vol. 14, No. 12, pp. 521–530.) The reflection coefficient is calculated as a function of λ for an e.m. wave incident

perpendicularly on a thin absorptive layer. Numerical and graphical methods are given for the evaluation of layer parameters which make the reflection coefficient as small as possible over a wide range of λ.

538.566: 535.42] + 534.26 **3344**

A Note on the Back-Scattering of a Circular Disk.—S. R. Seshadri. (*Proc. nat. Inst. Sci. India*, Part A, 26th Nov. 1960, Vol. 26, No. 6, pp. 609–616.) Asymptotic series are obtained for the back-scattering cross-sections of an acoustically hard disk, an acoustically soft disk and a perfectly conducting disk.

538.566: 535.42 **3345**

The Diffraction of Electromagnetic Waves at Rectangular Apertures in Plane Metal Screens.—H. Severin & K. Körper. (*Z. angew. Phys.*, Jan. 1961, Vol. 13, No. 1, pp. 41–47.) An approximation method of calculating the diffraction field [see e.g. 2694 of 1951 (Severin)] is applied to the case of rectangular apertures; results are compared with those obtained experimentally.

538.566: 535.42 **3344**

Diffraction by an Elliptic Cone.—I. Kraus & L. M. Levine. (*Commun. pure appl. Math.*, Feb. 1961, Vol. 14, No. 1, pp. 49–68.) Two Green's functions are derived for the reduced wave equation in the exterior or interior of an elliptic cone.

538.566: 535.43 **3345**

A Note on the Back-Scattering by an Infinite Strip.—S. R. Seshadri. (*Proc. nat. Inst. Sci. India*, Part A, 26th Nov. 1960, Vol. 26, No. 6, pp. 603–608.) The first few terms in the asymptotic series of the back-scattering cross-section of an infinite strip lying in a plane perpendicular to the direction of propagation of an e.m. wave are calculated, for all angles of incidence.

538.566: 535.43 **3346**

Scattering of a Surface Wave by a Discontinuity in the Surface Reactance on a Right-Angled Wedge.—F. C. Karal, Jr, S. N. Karp, T. S. Chu & R. G. Kouyoumjian. (*Commun. pure appl. Math.*, Feb. 1961, Vol. 14, No. 1, pp. 35–48.) An examination of the e.m. field produced when a surface wave travels along the front face of a right-angled wedge and is scattered by the tip.

538.566: 535.43 **3347**

An Experimental Study of Bistatic Scattering from some Small, Absorber-Coated, Metal Shapes.—R. J. Garbacz & D. L. Moffatt. (*Proc. Inst. Radio Engrs*, July 1961, Vol. 49, No. 7, pp. 1184–1192.) The absorber coating reduces energy scattering in the back hemisphere but increases the energy scattered in the forward hemisphere.

538.569.4: 538.22 **3348**

Mechanisms of Double Resonance in Solids.—J. Lambe, N. Laurance, E. C. McIrvine & R. W. Terhune. (*Phys. Rev.*, 15th May 1961, Vol. 122, No. 4, pp. 1161–1170.)

538.569.4: 538.221 **3349**

Ferromagnetic Relaxation: Part 1—Theory of the Relaxation of the Uniform Precession and the Degenerate Spectrum in Insulators at Low Temperatures.—M. Sparks, R. London & C. Kittel. (*Phys. Rev.*, 1st May 1961, Vol. 122, No. 3, pp. 791–803.) Scattering by surface pitting imperfections, equalization of degenerate-mode populations, and Raman scattering are considered theoretically and compared with experiment.

538.569.4: 538.221 **3350**

Theory of Magnetostatic Modes in Long, Axially Magnetized Cylinders.—R. I. Joseph & E. Schlömann. (*J. appl. Phys.*, June 1961, Vol. 32, No. 6, pp. 1001–1005.) The characteristic equation determining the eigen frequencies of the magnetostatic modes is derived from the equations of motion and the boundary conditions.

538.569.4: 538.221 **3351**

Instability of Spin Waves and Magnetostatic Modes in a Microwave Magnetic Field Applied Parallel to the D.C. Field.—E. Schlömann & R. I. Joseph. (*J. appl. Phys.*, June 1961, Vol. 32, No. 6, pp. 1006–1016.) Two methods of calculating the instability threshold are described, a plane-wave analysis strictly applicable only to an infinite medium and a more rigorous theory in which the boundary conditions at the surface of the sample are taken into account.

538.569.4: 538.222 **3352**

The Role of Phonons in Paramagnetic Relaxation.—B. W. Faughnan & M. W. P. Strandberg. (*J. Phys. Chem. Solids*, April 1961, Vol. 19, Nos. 1/2, pp. 155–166.) Theory is given for the coupled spin-lattice-bath system, with nonequilibrium phonons. Experiments fail to indicate the presence of such phonons.

538.569.4: 621.375.9: 535.61-2 **3353**

Observation of Forbidden Resonances in Optically Driven Spin Systems.—W. E. Bell & A. L. Bloom. (*Phys. Rev. Lett.*, 1st June 1961, Vol. 6, No. 11, pp. 623–624.)

538.569.4: 621.375.9: 535.61-2 **3354**

Thermal Tuning of Ruby Optical Maser.—I. D. Abella & H. Z. Cummins. (*J. appl. Phys.*, June 1961, Vol. 32, No. 6, pp. 1177–1178.)

GEOPHYSICAL AND EXTRATERRESTRIAL PHENOMENA

523 + 55] : 621.396 **3355**

Radio Techniques and Space Research.—(*Wireless World*, Aug. 1961, Vol. 67, No. 8, pp. 394–395.) A brief review of the papers on radio topics presented at the British I.R.E. Convention, 1961.

523.15 **3356**

The Stability of Force-Free Magnetic Fields.—B. B. Chakraborty & P. L. Bhatnagar. (*Proc. nat. Inst. Sci. India*, Part A, 26th Nov. 1960, Vol. 26, No. 6, pp. 592–597.) The condition is derived for a force-free magnetic field to exercise a stabilizing influence on an equilibrium configuration; several cases are given for which the condition is satisfied. See also 784 of 1959 (Woltjer).

523.164 **3357**

The Technique of Radio Astronomy.—F. Tank. (*Bull. schweiz. elektrotech. Ver.*, 15th Feb. 1961, Vol. 52, No. 3, pp. 69–75.) Review of applications of radio techniques in modern astronomy, including radio telescopes, interferometers and echo equipment.

523.164 **3358**

Results of Radio Astronomy.—M. Waldmeier. (*Bull. schweiz. elektrotech. Ver.*, 15th Feb. 1961, Vol. 52, No. 3, pp. 75–80.) Review of the field of radio-astronomy measurements, particularly with regard to solar observations.

523.164: 621.317 **3359**

Radio Astronomy.—P. G. Mezger. (*Nachrichtentech. Z.*, Dec. 1960, Vol. 13, No. 12, pp. 579–591.) Various measurement techniques in the three main fields of research are described and their limitations discussed.

523.164: 621.396.677.833.2 **3360**

The Radio Telescope Interferometer at the Royal Radar Establishment.—J. S. Hey. (*Nature, Lond.*, 24th June 1961, Vol. 190, No. 4782, pp. 1150–1152.) Two mobile and steerable radio telescopes, with parabolic reflectors 25 m in diameter, are used either separately or in conjunction as an interferometer. The system is designed to operate in a wide frequency range down to 10 cm λ.

523.164.3 **3361**

A New Source of Centimetre Radio Waves.—Yu. N. Parijskij. (*Dokl. Ak. Nauk S.S.S.R.*, 11th March 1961, Vol. 137, No. 2, pp. 307–309.) During observations carried out at Pulkov Observatory on March 1959 on 9·4 cm λ, a new r.f. source, of energy $> 3 \times 10^{26}$ erg, was detected in the galactic plane, the co-ordinates being $\alpha_{1950} = 18^h\ 53^m\ 38^s$ and $\delta_{1950} = 1°\ 15'$.

523.164.3: 523.3 **3362**

Lunar Occultation of a Radio Source.—C. Hazard. (*Nature, Lond.*, 1st July 1961, Vol. 191, No. 4783, p. 58.) By observation of the times of disappearance and reappearance of a radio star behind the moon, the position of the source can be obtained with great accuracy. Taking into account all sources of error, the estimated position is probably correct to within 5″ of arc.

523.164.32 **3363**

Solar Radio Astronomy in Italy.—G. Righini. (*Ricerca sci.*, Part 1, Jan. 1961, Vol. 1, No. 1, pp. 25–37.) The development of radio astronomy outside and inside Italy is traced, and details are given of installations at the Astrophysical Observatory at Arcetri. Some results of observations made there are illustrated and discussed.

523.164.32 **3364**

Observations of 26·3-Mc/s Solar Radio Noise during August 1959.—W. C. Erickson. (*J. geophys. Res.*, June 1961, Vol. 66, No. 6, pp. 1773–1780.) Solar r.f. noise during the noise storm in August 1959 showed that the intense amplitude scintillation does not appear to extend down to

frequencies as low as 26 Mc/s, and that the 26-Mc/s storm both began and ended before the m-λ storm did so.

523.164.32 **3365**

Very-Low-Frequency Modulation of Discrete-Frequency Solar Noise Bursts. J. Aarons, S. Basu, W. Kidd & R. Allen. (*Nature, Lond.*, 1st July 1961, Vol. 191, No. 4783, pp. 56–57.) Measurements of Type II and Type IV bursts at 220, 400 and 3 000 Mc/s show envelope fluctuations which were examined over the range 5–550 c/s. The observed narrow-band structure is illustrated.

523.164.32: 523.75 **3366**

A Relation between Solar Radio Emission and Low-Energy Solar Cosmic Rays.—K. Sakurai & H. Maeda. (*J. geophys. Res.*, June 1961, Vol. 66, No. 6, pp. 1966–1969.)

523.164.4 **3367**

Characteristics of the NGC 4486 Radio Emission.—Yu. N. Parilskiĭ. (*Dokl. Ak. Nauk S.S.S.R.*, 1st March 1961, Vol. 137, No. 1, pp. 49–50.) Observations carried out with the Pulkov radio telescope of Virgo-A showed that the angular extensions of the r.f. source on 9·4 cm are smaller than those determined by Mills on 3·5 m. Brightness distribution depended essentially on wavelength.

523.165 **3368**

Radiation Measurements of 1 500 Kilometres Altitude at Equatorial Latitudes.—F. E. Holly, L. Allen, Jr, & R. G. Johnson. (*J. geophys. Res.*, June 1961, Vol. 66, No. 6, pp. 1627–1639.) The relative fluxes, energy spectra, and angular distributions of electrons and protons determined during three flights are reported. The electron spectrum appears to be softer than that expected from a neutron beta-decay origin.

523.165 **3369**

Effect of Hydromagnetic Waves on the Lifetime of Van Allen Radiation Protons.—A. J. Dragt. (*J. geophys. Res.*, June 1961, Vol. 66, No. 6, pp. 1641–1649.) Hydromagnetic waves with frequency less than 5 c/s and amplitude 3 γ at two or three earth radii are capable of removing all high-energy outer-belt protons (maximum energy ≈ 10 MeV) in about ½ day. If an albedo neutron source is assumed for the inner-belt protons the calculated proton flux, as a function of radial distance from the earth, agrees well with Pioneer III results.

523.165: 523.75 **3370**

Cosmic-Ray Phenomena during the November 1960 Solar Disturbances.—J. G. Roederer, J. R. Manzano, O. R. Santochi, N. Nerurkar, O. Trumoso, R. A. R. Palmeira & G. Schwachheim. (*J. geophys. Res.*, June 1961, Vol. 66, No. 6, pp. 1603–1610.) Cosmic-ray data for high- and middle-latitude stations are examined to investigate the interaction of a solar-flare increase and Forbush decrease.

523.165: 523.75 **3371**

The Spectrum and Propagation of Relativistic Solar Flare Particles during July 17–18, 1959.—H. S. Ghielmetti. (*J. geophys. Res.*, June 1961, Vol. 66, No. 6, pp. 1611–1625.) An examination of cosmic-ray data reveals two increases of solar protons for which the time variations are quite different. This difference is attributed to a change in the interplanetary field.

523.3 + 523.4]: 621.396.96 **3372**

A Theory of Radar Reflection from the Moon and Planets.—F. B. Daniels. (*J. geophys. Res.*, June 1961, Vol. 66, No. 6, pp. 1781–1788.) Relations between the surface statistics of an irregular radar target and the angular power spectrum and autocorrelation function of the reflected signal are derived. The spatial correlation function is also computed. The theory is used to investigate the small-scale structure of the moon's surface.

523.53 **3373**

Meteorites and Meteors.—N. Carrara. (*Ricerca sci.*, Part 1, Jan. 1961, Vol. 1, No. 1, pp. 14–24.) A general outline of the field of meteor studies with a few details of meteor tracking equipment at the Microwave Centre in Florence and results obtained there.

523.53 **3374**

The Distribution of Meteor Masses for Sporadic Meteors and Three Showers.—A. A. Weiss. (*Aust. J. Phys.*, March 1961, Vol. 14, No. 1, pp. 102–119.) Distributions of maximum line densities in meteor trails are derived from radio echo data for sporadic and shower meteors.

523.53: 621.396.96 **3375**

Attachment Processes in Meteor Trails.—J. S. Greenhow & J. E. Hall. (*J. atmos. terr. Phys.*, July 1961, Vol. 21, No. 4, pp. 261–271.) The effects of electron attachment to neutral particles on the characteristics of long-duration meteor echoes are considered. Two-body and three-body attachment processes produce differing effects and these are compared with observations. See also 2339 of 1960 (Davis et al.).

523.53: 621.396.96 **3376**

The Characteristics of Persistent Sporadic Meteor Echoes.—J. W. Smith. (*Aust. J. Phys.*, March 1961, Vol. 14, No. 1, pp. 89–101.) For sporadic meteors whose trails have an electron line density greater than 10^{13} electrons/cm, the observed distribution of meteor echo duration cannot be explained by power-law distributions. There is no significant seasonal or diurnal variation in the mass distribution of the meteors examined.

523.53: 621.396.96 **3377**

A Possible Explanation of the Long-Duration Radar Echoes of Ionized Trails in the Upper Atmosphere.—C. L. Tang. (*J. geophys. Res.*, June 1961, Vol. 66, No. 6, pp. 1974–1975.) In ionospheric regions where the plasma frequency is near the frequency of the incident wave, the local wavelength of the latter is very long and the destructive interference of the fields scattered from the dispersed trail is less effective.

523.53: 621.396.96 **3378**

Volume Density of Radio Echoes from Meteor Trails in Radar-Type Reception.—N. Carrara, P. F. Checcacci, A. Consortini & L. Ronchi. (*Alta Frequenza*, Dec. 1960, Vol. 29, No. 6, pp. 615–638.) The echo density is evaluated taking account of trail orientation, the meteor evaporation process and the characteristics of the transmitter/receiver system used for back-scatter reception.

523.53: 621.396.96 **3379**

Volume Density of Reflection Points of Meteor Trails in Radio Links.—N. Carrara, P. F. Checcacci, L. Ronchi & G. Tassinario. (*Alta Frequenza*, Dec. 1960, Vol. 29, No. 6, pp. 639–652.) The procedure developed for back-scatter systems (3378 above) is applied to the case of forward-scatter links.

550.385.35: 523.75 **3380**

Geomagnetic Crochet of 15 November 1960.—M. Yasuhara & H. Maeda. (*J. atmos. terr. Phys.*, July 1961, Vol. 21, No. 4, pp. 289–293.) Discussion of the geomagnetic and ionospheric effects of a large solar flare.

550.385.4 **3381**

A Possible Explanation of *sc Observed at High Geomagnetic Latitudes.**—T. Ondoh. (*J. atmos. terr. Phys.*, July 1961, Vol. 21, No. 4, pp. 284–286.) An explanation of *sc** is given in terms of hydromagnetic waves propagating along the geomagnetic field lines.

551.507.362.2 **3382**

The Scientific Uses of Earth Satellites.—J. H. Blythe. (*Marconi Rev.*, 2nd Quarter 1961, Vol. 24, No. 141, pp. 84–97.) A survey is given of the effect of the use of artificial satellites on measurements relating to the gravitational field, the atmosphere, the upper ionosphere, magnetic fields near to the earth and in interplanetary space, and the zones of trapped radiation.

551.507.362.2 **3383**

On Simulation Studies of Motion of Bodies in Ionized Atmosphere.—K. P. Chopra. (*Z. Phys.*, 27th Jan. 1961, Vol. 161, No. 4, p. 445–453. In English.) The problems involved in laboratory model studies on satellite motion in an ionized atmosphere are analysed. Scaling relations obtained satisfy the conditions for aerodynamic, magneto-hydrodynamic and electrodynamic similitude. Flight conditions corresponding to the earth's upper atmosphere can be simulated by suitable scaling of the test model.

551.507.362.2 **3384**

On the Long-Period Luni-solar Effect in the Motion of the Artificial Satellite.—P. Musen. (*J. geophys. Res.*, June 1961, Vol. 66, No. 6, pp. 1659–1665.) Formulae for the determination of long-period effects caused by the sun and the moon on the motion of satellites and the stability of their orbits are developed.

551.507.362.2 **3385**

Rapid Variations of the Rotation Period of the Second Soviet Artificial Earth Satellite with respect to the Transverse Axis.—V. M. Grigorovskiĭ. (*Dokl. Ak. Nauk S.S.S.R.*, 21st March 1961,

Vol. 137, No. 3, pp. 572–575.) A table is given of data on the rotation period during March/April 1958.

551.507.362.2 **3386**

Determination of the Vertical Distribution of Ozone by Satellite Photometry.—S. V. Venkateswaran, J. G. Moore & A. J. Krueger. (*J. geophys. Res.*, June 1961, Vol. 66, No. 6, pp. 1751–1771.)

551.507.362.2 **3387**

Density of the Upper Atmosphere Determined from Satellite Orbits, and its Variation during 1957–61.—D. G. King-Hele & D. M. C. Walker. (*Nature, Lond.*, 8th July 1961, Vol. 191, No. 4784, pp. 114–118.) Calculations from the orbits of 29 satellites in the height range 180–700 km show a decrease in density as the sunspot activity declined between 1957 and 1961. The influence of latitude on density and the large day-to-night variation above 400 km are also considered.

551.507.362.2 : 551.510.535 : 621.3.087.4 **3388**

Satellite Sounder and Telemeter chart Ionosphere Electron Density.—S. Horowitz and L. Humphrey. (*Electronics*, 23rd June 1961, Vol. 34, No. 25, pp. 50–53.) A satellite-borne ionosonde is described which is to be launched (into a 2 000 km orbit) by the U.S.A. Measurements will be made on six log-spaced frequencies between 3 and 15 Mc/s, by transmitting 20 pulses of each frequency in turn: crossed dipole receiving aerials are connected in phase quadrature, and the receiver is arranged to receive 10 echo pulses of one polarization and then 10 pulses of opposite polarization. A transistorized transmitter gives a peak power of 150 W with pulse length 500 μs. Data will be recorded by the satellite and transmitted on command to ground stations.

551.510.535 : 536 **3389**

The Atmospheric Density in the Earth's Ionosphere and Exosphere.—H. K. Paetzold. (*Naturwissenschaften*, Jan. 1961, Vol. 48, No. 2, pp. 39–40.) The atmospheric density distribution in the exosphere and the F layer, as determined from satellite observations, is plotted, and causes of density fluctuations with height are briefly discussed.

551.510.535 **3390**

Rate of Ion-Atom Interchange.—D. R. Bates & M. Nicolet. (*J. atmos. terr. Phys.*, July 1961, Vol. 21, No. 4, pp. 286–287.) Conclusions about the rate of conversion of atomic ions into molecular ions in the ionosphere (*ibid.*, April 1960, Vol. 18, No. 1, pp. 65–70) are reviewed, and an alternative suggestion [1859 of June (Hertzberg)] is discounted.

551.510.535 **3391**

Density Fluctuations in a Plasma in a Magnetic Field, with Applications to the Ionosphere.—T. Hagfors. (*J. geophys. Res.*, June 1961, Vol. 66, No. 6, pp. 1699–1712.) General expressions are derived for the fluctuation in density of electrons, ions and net charge in a plasma in thermal equilibrium in an external magnetic field. Coulomb interaction and two-body collisions are taken into account. The total scattered power and Doppler spectrum is calculated for incoherent scatter from the ionosphere at 300–2 000 km with a radar at 50–3 000 Mc/s. The total power is unaffected by the magnetic field, but resonance peaks at multiples of the ion gyro-frequency appear in the spectrum when the radar beam is within 5° of orthogonality with the field lines.

551.510.535 **3392**

Extensions of the 'Chapman' Theory of Layer Formation.—C. H. Cummack. (*J. geophys. Res.*, June 1961, Vol. 66, No. 6, pp. 1685–1697.) "An attempt has been made to establish some of the theorems necessary for the extension of the 'Chapman' theory of layer formation to the case where a spectrum of ionizing radiation acts on an atmosphere with any temperature profile. Some invariant properties of the electron production function have been established, and they have proved useful in estimating the temperature and temperature variations in the ionosphere."

551.510.535 **3393**

Theory of Electrostatic Fields in the Ionosphere at Polar and Middle Geomagnetic Latitudes.—J. R. Spreiter & B. R. Briggs. (*J. geophys. Res.*, June 1961, Vol. 66, No. 6, pp. 1731–1744.) Analysis of the elongated e.s. fields which provide the coupling in the dynamo-motor concept of the E and F regions. The e.s. field is taken to be of arbitrary horizontal scale, and numerical solutions are determined for the attenuation of the field with height. Fields with a horizontal scale as small as 3 or 4 km can extend from 130 to 400 km height with a reduction of only about 25%, but the coupling efficiency is critically dependent on ionospheric conditions.

551.510.535 **3394**

Photoionization Heating in the F Region of the Atmosphere.—D. C. Hunt & T. E. Van Zandt. (*J. geophys. Res.*, June 1961, Vol. 66, No. 6, pp. 1673–1682.) An estimate of the total F-region heating due to photoionization is made, based on a comparison of theoretical and observed models of several atmospheric parameters. The heat flux due to photoionization is estimated to be approximately 1·0 erg cm^{-2} sec which would be a major, if not predominant, source of heat in this region.

551.510.535 **3395**

Observations on the Ionospheric F Layer at Night: Part I—Height of Maximum Ionization, Critical Frequency and 'Semi-thickness' of F layer at Night.—C. S. G. K. Setty. (*J. Sci. Industr. Res., India*, Jan. 1961, Vol. 7, No. 1, pp. 21–26.) Measurements taken at Cambridge, England, agree with those for other stations. The scale height determined from the 'semi-thickness' of the layer is too small when compared with rocket and satellite observations.

551.510.535 **3396**

Group and Phase Velocities of a Travelling Disturbance in the F Region of the Ionosphere.—L. H. Hyder & J. D. Whitehead. (*Nature, Lond.*, 8th July 1961, Vol. 191, No. 4788, p. 137.) The disturbances cause gross distortions of ionogram records, and have a velocity of about 10 km/min. They are associated with sporadic-E patches having a velocity of about 5 km/min which is the phase velocity of the disturbances.

551.510.535 **3397**

On Vertical Drift Velocities of the F_2 Layer.—H. Unz. (*J. atmos. terr. Phys.*, July 1961, Vol. 21, No. 4, pp. 237–242.) Vertical drift velocities in the F_2 layer are deduced by evaluating the equation of continuity of electron density, and compared with observed movements. Some correlation is found.

551.510.535 : 523.164 **3398**

A Statistical Study of Ionospheric Drifts Measured by the Radio Star Scintillation Technique.—H. J. A. Chivers. (*J. atmos. terr. Phys.*, July 1961, Vol. 21, No. 4, pp. 221–224.) The method gives the E–W component of the drift velocity throughout the day. This component is commonly found to reverse suddenly near 2300 L.T. but the complementary reversal occurs at a less definite time during the following day.

551.510.535 : 551.507.362.1 **3399**

Rocket Measurements of F-Layer Electron Density and their Interpretation.—S. A. Bowhill. (*J. atmos. terr. Phys.*, July 1961, Vol. 21, No. 4, pp. 272–283.) Theoretical considerations about the shape of the electron density profile near the F_2 peak are compared with data obtained from rockets [882 of March (Nisbet & Bowhill)]. The results are consistent with day and night temperatures of about 1 500 °K and 1 200 °K respectively. Numerical values of the loss coefficient and other parameters are given.

551.510.535 : 551.507.362.1 **3400**

An Ion-Trap Measurement of the Ion Concentration Profile above the F_2 Peak.—W. B. Hanson & D. D. McKibbin. (*J. geophys. Res.*, June 1961, Vol. 66, No. 6, pp. 1667–1671.) The results of a winter evening rocket flight give the ion concentration from 240 to 750 km, and indicate a constant scale height (152 km) above 350 km.

551.510.535 : 551.507.362.2 **3401**

An Annual Variation of the Density of the Upper Atmosphere of the Earth.—H. K. Paetzold. (*Z. Naturf.*, Jan. 1961, Vol. 16a, No. 1, pp. 50–56.) The various causes of the fluctuations of upper air densities (see e.g. 1839 of June) which result in observed changes of satellite orbits are discussed. The possible influence of interplanetary matter and of an interstellar wind is mentioned.

551.510.535 : 621.3.087.4 **3402**

Active High-Frequency Spectrometers for Ionospheric Sounding: Part 4—Numerical Recording of Delay Times.—E. Harnischmacher & H. Porsche. (*Arch. elekt. Übertragung*, Nov. 1960, Vol. 14, No. 11, pp. 505–507.) Equipment for the automatic determination and printing of echo heights in numerical form is described. Part 3: 2973 of September (Paul).

551.510.535: 621.3.087.4 **3403**

Active High-Frequency Spectrometers for Ionospheric Sounding: Part 5—Methods of Automatic Determination of True Height.—A. K. Paul, H. Porsche & K. Rawer. (*Arch. elekt. Übertragung*, Dec. 1960, Vol. 14, No. 12, pp. 561–569.) The direct evaluation of $N(h)$ profiles from the echo delays measured at the output of an ionosonde is proposed. Three digital and three analogue methods are discussed and block diagrams given. Part 4: 3402 above.

551.510.536 **3404**

Density in a Planetary Exosphere.—J. Herring & L. Kyle. (*J. geophys. Res.*, June 1961, Vol. 66, No. 6, pp. 1980–1982.)

551.510.536: 621.396.96 **3405**

Evidence on the Laminar Nature of the Exosphere Obtained by means of Guided High-Frequency Wave Propagation.—R. M. Gallet & W. F. Utlaut. (*Phys. Rev. Lett.*, 1st June 1961, Vol. 6, No. 11, pp. 591–594.) Radar pulses at 14 Mc/s were transmitted in the direction of the earth's magnetic field from Washington, D.C. Delayed echoes were found on many occasions from distances between 20 000 and 30 000 km. Each echo remained at a constant range. A possible explanation is given.

551.594.5 **3406**

Orientation of Polar Auroras.—J. V. Denholm & F. R. Bond. (*Aust. J. Phys.*, March 1961, Vol. 14, No. 1, pp. 193–195.) Observations of 'homogeneous arc' auroras at three antarctic stations are presented and show a diurnal variation of orientation, thus supporting the observations of Weill (*C.R. Acad. Sci., Paris*, 15th May 1958, Vol. 246, No. 20, pp. 2925–2927.)

551.594.5 **3407**

The East-West Drift of Auroral Forms determined from All-Sky Camera Films.—W. Stoffregen. (*J. atmos. terr. Phys.*, July 1961, Vol. 21, No. 4, pp. 257–260.)

551.594.5 **3408**

Thickness of an Active Auroral Curtain.—S. I. Akasofu. (*J. atmos. terr. Phys.*, July 1961, Vol. 21, No. 4, pp. 287–288.)

551.594.5: 621.396.96 **3409**

Models of Auroral Ionization: Part 1—Auroral Ionization Models and their Radio-Reflection Characteristics.—D.R. Moorcroft. (*Canad. J. Phys.*, May 1961, Vol. 39, No. 5, pp. 677–694.) Several general models of auroral ionization are developed. By considering the ionization as an assembly of scattering centres, it is possible to include a unified treatment of weak scattering and critical reflection.

551.594.5: 621.396.96 **3410**

Models of Auroral Ionization: Part 2—Applications to Radio Observations of Aurora.—D. R. Moorcroft. (*Canad. J. Phys.*, May 1961, Vol. 39, No. 5, pp. 695–715.) The radio reflection characteristics are examined in the light of the theory developed in 3409 above. Critical reflection at 30–50 Mc/s implies electron densities up to 3×10^{10} electrons/cm^3. The observations are consistent with the existence of clouds of electrons elongated in the ratio of 5 or 10 : 1 parallel to the field lines and a few metres in diameter perpendicular to the field.

551.594.6 **3411**

Atmospheric Noise Levels from 0·6 to 10 Kilocycles per Second.—L. H. Ginsberg & D. J. Blattner. (*J. geophys. Res.*, June 1961, Vol. 66, No. 6, pp. 1745–1749.) A comprehensive series of observations on atmospheric noise in California and Florida for frequencies below 10 kc/s is described and analysed. The diurnal variation for N–S loop orientation is a minimum in the interval 0400–1200 L.T. at both sites, and minimum noise levels are found to occur between 3 and 5 kc/s. The latter result is in agreement with the theory of Wait (2886 of 1957).

551.594.6 **3412**

A Study of Whistling Atmospherics: Part 1—Occurrence.—J. Crouchley. (*Aust. J. Phys.*, March 1961, Vol. 14, No. 1, pp. 22–39.) Results of I.G.Y. whistler observations at Brisbane, Adelaide, Hobart and Macquarie Island are presented, and the seasonal, diurnal and latitude variations of incidence of occurrence are discussed.

551.594.6 **3413**

A Study of Whistling Atmospherics: Part 2—Diffuseness.—J. Crouchley & R. J. Finn. (*Aust. J. Phys.*, March 1961, Vol. 14, No. 1, pp. 40–56.) Diffuseness, defined as the average time duration of whistler energy on a fixed frequency, is found to be twice as large for long as for short whistlers, to be independent of season and time of day, and to be linearly related to geomagnetic latitude and whistler dispersion. Part 1: 3412 above.

551.594.6: 550.385.37 **3414**

Observations of Hydromagnetic Emissions.—L. R. Tepley. (*J. geophys. Res.*, June 1961, Vol. 66, No. 6, pp. 1651–1658.) A frequency/time analysis of geomagnetic pulsations was made in the range 0·5–5 c/s for the period 18th–21st November 1960. The oscillations were observed simultaneously in California and Nevada and were probably influenced by solar flares which occurred before and during the dates mentioned.

551.594.6: 621.391.812.63 **3415**

Two-Hop 18·6-kc/s Whistler-Mode Echoes Received at Seattle.—Willard. (See 3528.)

LOCATION AND AIDS TO NAVIGATION

621.396.933 **3416**

Servo Filter and Gain Control Improve Automatic Direction Finder.—P. V. Sparks. (*Electronics*, 9th June 1961, Vol. 34, No. 23, pp. 110–113.) The principles and circuit details of a light-weight low-power airborne d.f. system are given. The goniometer is driven by a servo system to keep it at the point of minimum gain. Ambiguity of the bearing is resolved by switching in a vertical sense aerial.

621.396.933: 621.376.56 **3417**

Pulse-Duration Coding as a Means of Increasing the Number of Channels in the Australian 200-Mc/s D.M.E. System.—B. R. Johnson. (*A.W.A. tech. Rev.*, Dec. 1960, Vol. 11, No. 3, pp. 129–142.) The number of channels is increased from 12 to 48 by the use of pulse-duration as well as the present pulse-separation coding. Interference from other beacons is reduced.

621.396.962.33: 621.318.43 **3418**

Magnetics in Doppler Signal Data Extraction.—Metz & Fay. (See 3265.)

621.396.969.18 **3419**

Principles of Three-Dimensional Radar Location (3-D Radar.)—K. Röhrich. (*Nachrichtentech. Z.*, Dec. 1960, Vol. 13, No. 12, pp. 571–576.) Review of existing techniques. 32 references.

MATERIALS AND SUBSIDIARY TECHNIQUES

533.5: 621.38 **3420**

The Interplay of Electronics and Vacuum Technology.—J. M. Lafferty & T. A. Vanderslice. (*Proc. Inst. Radio Engrs*, July 1961, Vol. 49, No. 7, pp. 1136–1154.) A review of modern ultra-high-vacuum systems and the electronic components used in them. 53 references.

535.215: 539.23 **3421**

Light Interference and Internal Photoeffect in Thin Photoconductive Films.—D. Kossel & W. Schmidt. (*Naturwissenschaften*, Feb. 1961, Vol. 48, No. 3, pp. 67–68.) Investigations were carried out on Sb_2S_3 films at $\lambda = 550$ mμ: absorption and photocurrent were measured as a function of film thickness to determine the effect of interference phenomena.

535.215: 546.47'221 **3422**

Infrared Enhancement and Quenching of Photoconduction in Single Crystals of ZnS : Cu.—F. G. Ullman & J. J. Dropkin. (*J. electrochem. Soc.*, Feb. 1961, Vol. 108, No. 2, pp. 154–159.) Photoelectric currents produced by infrared radiation may either enhance or quench the currents resulting from ultraviolet irradiation of the crystals.

535.215: 546.48'221 **3423**

Low-Field Breakdown, Non-ohmic Conductivity, and Photoconductivity of CdS at Low Temperatures.—H. Shenker. (*J. Phys. Chem. Solids*, April 1961, Vol. 19, Nos. 1/2, pp. 1–7.)

535.37: 539.12.04 **3424**

Luminescence Damage of Inorganic Phosphors by Ions.—R. Grasser & A. Scharmann. (*Z. Naturf.*, Jan. 1961, Vol. 16a, No. 1, pp. 10–12.) The effect on luminescence of ion bombardment is investigated as a function of ion mass and energy. See also 1440 of 1958 (Martin).

535.37: 546.47'221: 539.12.04 **3425**

Effects of α Radiation on Zinc Sulphide Phosphors.—N. Riehl, R. Siemsen & O. J. Stadler. (*Z. Naturf.*, Jan. 1961, Vol. 16a, No. 1, pp. 13–20.) Investigation of changes in glow curves and the luminescence spectrum of ZnS and ZnO phosphors following irradiation by α particles. No new glow curves were found.

537.226: 539.23 **3426**

Anomalous Capacitance of Thin Dielectric Structures.—C. A. Mead. (*Phys. Rev. Lett.*, 15th May 1961, Vol. 6, No. 10, pp. 545–546.) Measurements are made of the capacitance across thin Ta oxide films on Ta using Au or Bi upper electrodes. This shows that the inverse of the capacitance varies linearly with film thickness, extrapolating to give an apparently non-infinite capacitance at zero thickness. This anomaly is explained by a density-dependent penetration of the oxide into the metal of the electrodes.

537.227 **3427**

Ferroelectricity in $Bi_4Ti_3O_{12}$ and its Solid Solutions.—E. C. Subbarao. (*Phys. Rev.*, 1st May 1961, Vol. 122, No. 3, pp. 804–807.)

537.227 **3428**

Effect of Two-Dimensional Mechanical Stress on the Dielectric Properties of Poled Ceramic Barium Titanate and Lead Zirconate Titanate.—R. F. Brown. (*Canad. J. Phys.*, May 1961, Vol. 39, No. 5, pp. 741–753.) The dielectric constant decreases and the dielectric loss increases with increasing stress; part of the change is irreversible and part reversible. The dielectric constant appears not to change instantaneously on application of stress but decreases linearly with the logarithm of time.

537.228.1: 548.0].001.4(083.7) **3429**

I.R.E. Standards on Piezoelectric Crystals: Measurements of Piezoelectric Ceramics, 1961.—(*Proc. Inst. Radio Engrs*, July 1961, Vol. 49, No. 7, pp. 1161–1169.) Standard 61 I.R.E. 14.81.

537.228.4 **3430**

Microwave Modulation of the Electro-optic Effect in KH_2PO_4.—I. P. Kaminow. (*Phys. Rev. Lett.*, 15th May 1961, Vol. 6, No. 10, pp. 528–530.) Light of wavelength about 8 000 Å is modulated at 9.25 Gc/s by a cavity-resonance method using the linear electro-optic effect of KDP crystals. The presence of the modulation is confirmed by two methods. Future developments and applications are suggested.

537.311.33 **3431**

Scattering of Electrons by Phonons and Impurities in Semiconductors.—H. Reiss & A. I. Anderman. (*Phys. Rev* 15th May 1961, Vol. 122, No. 4, pp. 1135–1140.) A formula is developed for the carrier mobility in the presence of both types of scattering in n-type semiconductors for small relaxation times.

537.311.33 **3432**

A Group of Ternary Semiconducting Compounds.—L. S. Polatnik, Yu. F. Komnik, V. M. Koshkin & E. K. Belova. (*Dokl. Ak. Nauk S.S.S.R.*, 1st March 1961, Vol. 137, No. 1, pp. 68–71.) The lattice parameters of six ternary semiconductors such as Cu_2GeSe_3, Cu_2SnS_3 and Cu_2GeTe_3 are given.

537.311.33: 538.63 **3433**

Some Theoretical Considerations on the Longitudinal - Magnetic - Field - Induced Oscillations in Semiconductors (the Oscillistor) and a Tentative Explanation.—A. C. Prior. (*Proc. phys. Soc.*, 1st June 1961, Vol. 77, No. 498, pp. 1121–1124.) Conditions under which oscillations have been observed are such that a system of circulating currents could arise. These currents would tend to increase the carrier concentration at one surface and oscillations of a relaxation type could result.

537.311.33: 538.63 **3434**

Esaki Tunnelling in the Presence of Magnetic Fields.—R. R. Haering & E. N. Adams. (*J. Phys. Chem. Solids*, April 1961, Vol. 19, Nos. 1/2, pp. 8–17.) The theory for Esaki tunnelling in the presence of a magnetic field is given for both transverse and longitudinal magnetic fields; it is shown that there are important qualitative differences between the two cases.

537.311.33: 539.23 **3435**

Use of Monomolecular Layers in Evaporated-Film Tunnelling Devices.—J. L. Miles & H. O. McMahon. (*J. appl. Phys.*, June 1961, Vol. 32, No. 6, pp. 1176–1177.) Samples have been made to measure tunnelling currents between Sn-Pb and Sn-In evaporated-film pairs by using a monolayer of Ba stearate as a barrier.

537.311.33: 546.23 **3436**

Space-Charge-Limited Current Flow and Deep Trapping in Selenium.—H. P. D. Lanyon & W. E. Spear. (*Proc. phys. Soc.*, 1st June 1961, Vol. 77, No. 498, pp. 1157–1165.) *I-V* characteristics show an ohmic part at low applied voltages and, with increasing hole injection, a V^3 region which precedes the trap-filled limit predicted by theory.

537.311.33: 546.24: 539.23 **3437**

Variation of Field-Effect Mobility and Hall-Effect Mobility with the Thickness of the Deposited Films of Tellurium.—S. K. Ghosh. (*J. Phys. Chem. Solids*, April 1961, Vol. 19, Nos. 1/2, pp. 61–65.) Experimental measurements of the mobilities and the conductivity of Te films are reported. A tentative explanation is given for the low values found for Hall mobility.

537.311.33: [546.28 + 546.289 **3438**

Field Emission from Silicon and Germanium; Field Desorption and Surface Migration.—F. G. Allen. (*J. Phys. Chem. Solids*, April 1961, Vol. 19, Nos. 1/2, pp. 87–99.) Desorption has been used to produce clean Ge patterns in a field-emission microscope.

537.311.33: [546.28 + 546.289 **3439**

Oxygen Adsorption on Silicon and Germanium.—H. D. Hagstrum. (*J. appl. Phys.*, June 1961, Vol. 32, No. 6, pp. 1020–1022.)

537.311.33: [546.28 + 546.289] : 538.569.4 **3440**

Cyclotron Resonance in Germanium and Silicon and the Effect of Negative Effective Masses.—Yu. Kagan. (*Zh. eksp. teor. Fiz.*, June 1960, Vol. 38, No. 6, pp. 1854–1865.) The frequency (effective-mass) spectra of degenerate semiconductors are determined for the case of a magnetic field parallel to the [001] axis. The existence of negative-frequency branches is demonstrated and the problem of negative absorption is considered.

537.311.33: 546.28 **3441**

Preparation of Uniform-Resistivity n-Type Silicon by Nuclear Transmutation.—M. Tanenbaum & A. D. Mills. (*J. electrochem. Soc.*, Feb. 1961, Vol. 108, No. 2, pp. 171–176.) The technique has been used to produce n-type Si with resistivity between 0·1 and 20 Ω. cm, uniform to within ± 5%.

537.311.33: 546.28 **3442**

The Manufacture of Silicon Single Crystals by the Czochralski Method.—G. Gregor. (*Z. angew. Phys.*, Jan. 1961, Vol. 13, No. 1, pp. 47–51.) Problems involved in obtaining crystals of highest purity and a homogeneous distribution of resistivity are discussed.

537.311.33: 546.28 **3443**

Investigations on the Diffusion of Minority Carriers from a Point on Silicon.—C. H. Champness. (*Canad. J. Phys.*, May 1961, Vol. 39, No. 5, pp. 754–767.) The field-free diffusion of minority carriers injected at a point has been studied and the time from injection to the maximum of the collector signal due to the arriving carriers has been measured for various emitter-collector distances. For different samples, the time to maximum varied as the distance raised to powers 1·2 and 1·6. The decay times following the maximum decreased with distance. The results may be explained by assuming that the effective lifetime is dependent on the excess carrier density and decreases as the emitter point is approached.

537.311.33: 546.28 **3444**

Theory of Microplasma Instability in Silicon.—R. J. McIntyre. (*J. appl. Phys.*, June 1961, Vol. 32, No. 6, pp. 983–995.) A statistical theory is presented to explain microplasma instability at the onset of avalanche in reverse-biased Si. The agreement between theory and experiment for the turn-off probability is sufficiently good to suggest that the turn-off mechanism is the correct one. This implies that microplasmas turn off because the number of carrier pairs happens to fluctuate to zero.

537.311.33: 546.28 **3445**

Study of Li-O Interaction in Si by Ion Drift.—E. M. Pell. (*J. appl. Phys.*, June 1961, Vol. 32, No. 6, pp. 1048–1051.) Ion drift in a reverse-biased p-n junction has been used to measure the effective drift mobilities of Li^+ between 20° and 125° C in Si samples with oxygen concentration up to $1·3 \times 10^{18}$ atoms/cm³.

537.311.33: 546.28 **3446**

Recombination Kinetics for Thermally Dissociated Li-B Ion Pairs in Si.—

E. M. Pell & F. S. Ham. (*J. appl. Phys.*, June 1961, Vol. 32, No. 6, pp. 1052–1063.)

537.311.33 : 546.28 **3447**

Surface Potential of Silicon.—C. T. Raymo, G. W. Brands & B. Schwartz. (*J. appl. Phys.*, June 1961, Vol. 32, No. 6, pp. 1165–1166.) A simple experimental method using the d.c. field effect is described.

537.311.33 : 546.28 **3448**

Valence Spin-Orbit Splitting and Conduction *g* Tensor in Si.—L. Liu. (*Phys. Rev. Lett.*, 15th June 1961, Vol. 6, No. 12, pp. 683–685.) An orthogonalized-plane-wave method is used for calculating the *g* factor of electrons in Si. The two-band approximation used by Roth (4288 of 1960) is shown to be inadequate.

537.311.33 : 546.28 : 621.317.3 **3449**

Radio-Frequency Carrier and Capacitive Coupling Procedures for Resistivity and Lifetime Measurements on Silicon.—I. R. Weingarten & M. Rothberg. (*J. electrochem. Soc.*, Feb. 1961, Vol. 108, No. 2, pp. 167–171.) By using an r.f. bridge capacitive-coupling technique, ohmic contacts are avoided when measuring lifetime by photoconductivity decay.

537.311.33 : 546.281'26 **3450**

Measurement of Minority-Carrier Lifetime in SiC by a Novel Electro-Luminescent Method.—G. G. Harman & R. L. Raybold. (*J. appl. Phys.*, June 1961, Vol. 32, No. 6, pp. 1168–1169.) The method is applicable to large-energy-gap semiconductors.

537.311.33 : 546.289 **3451**

Acoustic-Mode Scattering of Holes.—M. Tiersten. (*IBM J. Res. Develapm.*, April 1961, Vol. 5, No. 2, pp. 122–131.) Matrix elements are calculated for acoustic-mode scattering of holes in the valence-band structure typified by Ge and a general expression for the electron-phonon interaction matrix element is obtained.

537.311.33 : 546.289 **3452**

Optical Constants of Germanium in the Region 0–27 eV.—O. P. Rustgi, J. S. Nodvik & G. L. Weissler. (*Phys. Rev.*, 15th May 1961, Vol. 122, No. 4, pp. 1131–1134.)

537.311.33 : 546.289 **3453**

Low-Temperature Thermal Resistance of *n*-Type Germanium.—R. W. Keyes. (*Phys. Rev.*, 15th May 1961, Vol. 122, No. 4, pp. 1171–1176.)

537.311.33 : 546.289 **3454**

Imaginary Part of X-Ray Scattering Factor for Germanium. Comparison of Theory and Experiment.—B. W. Batterman. (*J. appl. Phys.*, June 1961, Vol. 32, No. 6, pp. 998–1001.)

537.311.33 : 546.289 **3455**

Kinetics of Donor Reactions in Oxygen-Doped Germanium.—C. S. Fuller. (*J. Phys. Chem. Solids*, April 1961, Vol. 19, Nos. 1/2, pp. 18–28.)

537.311.33 : 546.289 : 539.12.04 **3456**

Effect of Fission-Spectrum Neutrons on n-Type Germanium.—D. Binder. (*Phys. Rev.*, 15th May 1961, Vol. 122, No. 4, pp. 1147–1148.) The electron removal rate per neutron is roughly constant.

537.311.33 : 546.289 : 539.12.08 **3457**

Effects of Monolayer Adsorption and Bombardment Damage on Auger Electron Ejection from Germanium.—H. D. Hagstrum. (*J. appl. Phys.*, June 1961, Vol. 32, No. 6, pp. 1015–1039.) See also 233 of January.

537.311.33 : 546.289 : 539.23 **3458**

Hall Effect and Conductivity of Vapour-Deposited Germanium Films.—F. Eckart & G. Jungk. (*Ann. Phys., Lpz.*, 30th Jan. 1961, Vol. 7, Nos. 3/4, pp. 210–215.) The films investigated exhibited *p*-type conductivity irrespective of the type of material used. The Hall coefficient was found to increase with magnetic field strength.

537.311.33 : 546.289 : 539.23 **3459**

Germanium Films on Germanium Obtained by Thermal Evaporation in Vacuum.—O. Weinreich, G. Dermit & C. Tatis. (*J. appl. Phys.*, June 1961, Vol. 32, No. 6, pp. 1170–1171.) The method of preparation and results of measurements are described.

537.311.33 : 546.681'19 **3460**

Determination of the Effective Ionic Charge of Gallium Arsenide from Direct Measurements of the Dielectric Constant.—K. G. Hamilton, C. Hilsum & R. R. Holeman. (*Proc. phys. Soc.*, 1st June 1961, Vol. 77, No. 498, pp. 1147–1148.)

537.311.33 : 546.681'86 **3461**

Diffusion of Tin in Gallium Arsenide.—B. Goldstein & H. Keller. (*J. appl. Phys.*, June 1961, Vol. 32, No. 6, pp. 1180–1181.)

537.311.33 : 546.682'19'241 **3462**

***Electrical and Optical Properties of* InAs-In_2Te_3 Alloys.**—J. C. Woolley, B. R. Pamplin & J. A. Evans. (*J. Phys. Chem. Solids*, April 1961, Vol. 19, Nos. 1/2, pp. 147–154.)

537.311.33 : 546.682'241 **3463**

Solid Solutions of In_2Te_3 in Sb_2Te_3 and Bi_2Te_3.—A. J. Rosenberg & A. J. Strauss. (*J. Phys. Chem. Solids*, April 1961, Vol. 19, Nos. 1/2, pp. 105–116.)

537.311.33 : 546.682'86 **3464**

Thermal Conductivity, Electrical Conductivity, Hall Effect and Thermo-E.M.F. of InSb.—G. Busch & E. Steigmeier. (*Helv. phys. Acta*, 15th Feb. 1961, Vol. 34, No. 1, pp. 1–28. In German.) Measurements were made on single-crystal material in the temperature range 195°–715°K. 49 references.

537.311.33 : 546.682'86 **3465**

Antimony Edge Dislocations in InSb.—H. C. Gatos, M. C. Finn & M. C. Lavine. (*J. appl. Phys.*, June 1961, Vol. 32, No. 6, pp. 1174–1175.)

537.311.33 : 546.817'241 : 538.63 **3466**

Observations of de Haas-van Alphen Oscillations in *p*-Type PbTe.—P. J. Stiles, E. Burstein & D. N. Langenberg. (*Phys. Rev. Lett.*, 15th June 1961, Vol. 6, No. 12, pp. 667–669.) Magnetic susceptibility oscillations, examined by pulsed-magnetic-field techniques, are reported.

537.311.33 : 546.824-31 **3467**

Electric Strength of Barium Single Crystals.—D. A. Powers & I. J. T. Johansen. (*J. appl. Phys.*, June 1961, Vol. 32, No. 6, pp. 1083–1085.)

537.311.33 : 546.863'873'241'231 **3468**

Relations between the Thermoelectric Properties and the Chemical Bonding of Sb-Bi-Te-Se Systems.—I. Tsumura & S. Takayanagi. (*J. Phys. Chem. Solids*, April 1961, Vol. 19, Nos. 1/2, pp. 128–129.)

537.311.33 : 546.873'241 **3469**

***n*- and *p*-Type Single-Crystal Bismuth Telluride.**—A. C. Yang & F. D. Shepherd. (*J. electrochem. Soc.*, Feb. 1961, Vol. 108, No. 2, pp. 197–198.) Both crystal types have been grown using the Czochralski method for pulling rates between 0·2 cm/h and 20 cm/h.

537.312.62 **3470**

Some New Superconducting Compounds.—B. T. Matthias, V. B. Compton & E. Corenzwit. (*J. Phys. Chem. Solids*, April 1961, Vol. 19, Nos. 1/2, pp. 130–133.) Superconductivity and crystal structure data are tabulated. The new compounds: $ThRu_3$, $ThOs_3$ and $ThIr_3$ have transition temperatures of 3·56, 1·51 and 1·52°K respectively.

537.312.62 **3471**

Study of Superconductors by Electron Tunnelling.—I. Giaever & K. Megerle. (*Phys. Rev.*, 15th May 1961, Vol. 122, No. 4, pp. 1101–1111.) The energy-gap width variation with temperature agrees with the Bardeen-Cooper-Schrieffer theory of superconductivity. The energy gap in thin films decreases with increasing applied magnetic field.

537.312.62 **3472**

Superconductivity at High Magnetic Fields and Current Densities in some Nb-Zr Alloys.—T. G. Berlincourt, R. R. Hake & D. H. Leslie. (*Phys. Rev. Lett.*, 15th June 1961, Vol. 6, No. 12, pp. 671–674.)

537.312.62 **3473**

Variation of the Elastic Moduli at the Superconducting Transition.—G. A. Alers & D. L. Waldorf. (*Phys. Rev. Lett.*, 15th June 1961, Vol. 6, No. 12, pp. 677–679.)

537.312.62 **3474**

First- and Second-Order Stress Effects on Superconducting Transitions in Ta and Sn.—D. P. Seraphim & P. M. Marcus. (*Phys. Rev. Lett.*, 15th June 1961, Vol. 6, No. 12, pp. 680–682.)

537.312.62 **3475**

Superconductivity in the Neighbourhood of Metallic Contacts.—L. N. Cooper. (*Phys. Rev. Lett.*, 15th June 1961, Vol. 6, No. 12, pp. 689–690.) Theoretical discussion of the effect described by Smith et al. (3476 on next page).

537.312.62 : 539.23 **3476**

Superconducting Characteristics of Superimposed Metal Films.—P. H. Smith, S. Shapiro, J. L. Miles & J. Nicol. (*Phys. Rev. Lett.*, 15th June 1961, Vol. 6, No. 12, pp. 686–688.) A report of experiments showing that a normal conductor film in contact with a superconducting film acts as a superconductor.

537.533 **3477**

Temperature Dependence of the Work Function of Metals (Ta, Mo).—G. Comas, A. Gelberg & B. Anthony. (*Phys. Rev.*, 15th May 1961, Vol. 122, No. 4, pp. 1092–1100.) Detailed report of measurements made using the electron-beam method.

537.611 **3478**

On the Thermionic Properties of $EuCl_2$ and a $EuCl_2$–KCl Mixture.—W. E. Danforth & A. J. Williams, III. (*J. appl. Phys.*, June 1961, Vol. 32, No. 6, pp. 1161–1162.)

538.221 **3479**

Ferromagnetism in Dilute Solutions of Cobalt in Palladium.—B. M. Boerstoel, P. A. Wolff, D. D. Elleman, V. B. Compton & J. M. Warnock. (*Phys. Rev.*, 15th May 1961, Vol. 122, No. 4, pp. 1157–1160.)

538.221 : 534.2[85.4] **3480**

The Influence of Bloch-Wall Displacements on the Attenuation of Ultrasonic Waves in Ferromagnetic Metals.—G. Simon. (*Ann. Phys., Lpz.*, 30th Jan. 1961, Vol. 7, Nos. 3/4, pp. 140–148.) The investigation of the dynamic behaviour of the Bloch walls is based on Kersten's model (1825 of 1957).

538.221 : 538.632 **3481**

Hall Effect and Resistance in the Iron-Cobalt Series.—W. Jellinghaus & M. P. de Andrés. (*Ann. Phys., Lpz.*, 30th Jan. 1961, Vol. 7, Nos. 3/4, pp. 149–158.) For results of measurements on Fe-Ni alloys *see ibid*, 15th Jan. 1960, Vol. 5, Nos. 3/4, pp. 187–199.

538.221 : 538.632 **3482**

Influence of Neighbour Elements of Iron on the Hall Effect of Mixed Crystals with High Iron Content.—W. Jellinghaus & M. P. de Andrés. (*Ann. Phys., Lpz.*, 30th Jan. 1961, Vol. 7, Nos. 3/4, pp. 189–200.)

538.221 : 539.23 **3483**

Polarity of the Domain Boundaries in Thin Ferromagnetic Films.—L. V. Kirenskiĭ & V. A. Buravikhin. (*Dokl. Ak. Nauk S.S.S.R.*, 21st Jan. 1961, Vol. 136, No. 3, pp. 575–576.) Results of experimental investigations show that in thin films Bloch walls are of alternating polarity and that the polarity in Néel boundaries is not sharply defined. With the application of a magnetic field perpendicular to the surface of the film this polarity becomes more distinct.

538.221 : 621.318.134 **3484**

A Neutron Diffraction Study of the Temperature Variation of the Spontaneous Sublattice Magnetization of Ferrites and the Néel Theory of Ferromagnetism.—T. Riste & L. Tenzer. (*J. Phys. Chem. Solids*, April 1961, Vol. 19, Nos. 1/2, pp. 117–125.)

538.221: 621.318.134 **3485**

The Ideal Magnetization Curve of Ferrites with Differing Hysteresis Loops.—M. Kornetzki & E. Rose. (*Z. angew. Phys.*, Jan. 1961, Vol. 13, No. 1, pp. 28–31.) The ideal magnetization curve is derived from Preisach diagrams obtained experimentally for various ferrites. A finite gradient at zero field strength, the ideal initial permeability, was found in all cases.

538.221: 621.318.134 **3486**

Measurement of Long-Term Magnetic After-Effects of Resonance in Ferrites.—F. Pilgrim. (*Ann. Phys., Lpz.*, 30th Jan. 1961, Vol. 7, Nos. 3/4, pp. 156–159.) Magnetometer equipment is described and test results obtained with Ni-Zn ferrites are given.

538.221: 621.318.134 **3487**

Square-Loop Ferrites with Temperature-Independent Properties and Improved Disturb Ratio.—R. S. Weiss. (*J. appl. Phys.*, June 1961, Vol. 32, No. 6, pp. 1152–1153.) Magnetic annealing of Mn-ferrous ferrites and Ni-ferrous ferrites has produced storage-type cores with improved properties. Preparation of the cores, their switching properties and an explanation of their behaviour are given.

538.221: 621.318.134 **3488**

Manganese-Zinc Ferrites with Different Types of Hysteresis Loop.—M. Kornetzki, E. Moser & E. Rose. (*Z. angew. Phys.*, Jan. 1961, Vol. 13, No. 1, pp. 31–36.) Normal, square, isoperm and perminvar types of hysteresis loop can be obtained by varying the Fe_2O_3 content of the ferrites investigated.

538.221: 621.318.134 **3489**

Elastic Constants of Single-Crystal YIG.—A. E. Clark & R. E. Strakna. (*J. appl. Phys.*, June 1961, Vol. 32, No. 6, pp. 1172–1173.)

538.221: 621.318.134: 534.13-8 **3490**

Extremely Low-Loss Acoustic Resonance in Single-Crystal Garnet Spheres.—R. C. LeCraw, E. G. Spencer & E. I. Gordon. (*Phys. Rev. Lett.*, 1st June 1961, Vol. 6, No. 11, pp. 620–622.) An acoustic resonance has been observed at 9·2 Mc/s in spheres of Y-Fe garnet at room temperature with losses an order of magnitude less than for other materials in similar conditions.

538.221 : 621.318.134 : 538.569.4 **3491**

Magnetic Resonance in Canted Ferrimagnets.—P. A. Miles. (*Phys. Rev.*, 15th May 1961, Vol. 122, No. 4, pp. 1143–1146.) It should be possible to detect and analyse the structure of canted ferrimagnets as their magnetic resonance spectra differ characteristically from ferrimagnets with collinear sublattices.

538.221 : 621.318.134 : 548.5 **3492**

Growth Orientation in Ferrite Single Crystals.—G. Elbinger & U. Rösler. (*Ann. Phys., Lpz.*, 12th Jan. 1961, Vol. 7, Nos. 1/2, pp. 111–112.) Note on results obtained using a very low pulling speed. See also 2725 of August (Rösler & Elbinger).

538.221: 621.391.625.3 **3493**

Magnetic Recording.—L. G. Schouten & J. Volkers. (*Electronic Technol.*, Aug. 1961, Vol. 38, No. 8, pp. 274–278.) A new theory of the magnetization of tape and the role played by a.c. bias is described. The theory accounts for several previously unexplained phenomena.

538.222: 534.[85.4]: 621.375.9 **3494**

Amplification of 9·3-Gc/s Ultrasonic Pulses by Phase Locking in Ruby.—E. B. Tucker. (*Phys. Rev. Lett.*, 15th May 1961, Vol. 6, No. 10, pp. 547–548.) Experimental evidence is produced for amplification of 9·3-Gc/s ultrasonic pulses by spin-phonon interaction in a pumped Linde pink crystal. The system was similar to that used previously to observe attenuation of these pulses (1962 of June) but with the spin population inverted. Experimental details are given and the conditions for realizing a phonon maser are briefly considered.

538.222: 537.228.1 **3495**

Splitting of the Emission Lines of Ruby by an External Electric Field.—W. Kaiser, S. Sugano & D. L. Wood. (*Phys. Rev. Lett.*, 1st June 1961, Vol. 6, No. 11, pp. 605–607.) An additional splitting of the doublet comprising each emission line is shown to take place in an external electric field. This effect should allow frequency modulation of the output of a ruby optical maser.

538.222: 538.569.4 **3496**

Paramagnetic Resonance of Gd^{3+} in Al_2O_3.—S. Geschwind & J. P. Remeika. (*Phys. Rev.*, 1st May 1961, Vol. 122, No. 3, pp. 757–761.) The substitution of Gd^{3+} impurities for Al^{3+} has been examined using the paramagnetic resonance spectrum at 24 Gc/s.

538.222: 538.569.4 **3497**

Paramagnetic Resonance of Cr^{3+} in Yttrium Oxide.—J. W. Carson, D. P. Devor & R. H. Hoskins. (*Phys. Rev.*, 15th May 1961, Vol. 122, No. 4, pp. 1141–1143.)

538.652 **3498**

Investigations on Magnetostrictive Circular Rings and Rods for the Determination of the Dynamic Magnetostrictive Coefficient as a Function of External Field Strength.—J. Narrog. (*Hochfrequenztech. u. Elektroakust.*, Dec. 1960, Vol. 69, No. 6, pp. 225–229.)

MATHEMATICS

517.918 **3499**

Concerning the Partition Theory and Associated Transform Methods.—E. V. Bohn. (*Proc. Inst. Radio Engrs*, July 1961, Vol. 49, No. 7, pp. 1215–1216.) Critical comment on earlier papers [e.g. 2854 of 1960 (Ku & Wolf)].

517.94: 621.372.5 **3500**

A Review of Methods of Linear Network Analysis in the Steady State: Parts 1 & 2.—Seymour. (See 3271.)

MEASUREMENTS AND TEST GEAR

621.317.3: 621.391.822 **3501**

A Voltage Comparator for Low-Frequency Noise Measurements.—F. A. Spelman. (*Elect. Engng, N.Y.*, March 1961, Vol. 80, No. 3, pp. 200–201.) A circuit is given which was designed to measure low-frequency noise in transistors but is suitable for the study of any noise in the range of 50–5 000 c/s.

621.317.3.029.6: 621.391.822 **3502**

Techniques of Microwave Noise Measurement.—B. G. Bosch & W. A. Gambling. (*J. Brit. Instn Radio Engrs*, June 1961, Vol. 21, No. 6, pp. 503–515.) Some aspects of microwave oscillator noise are discussed and measurement techniques applicable to oscillators and to modulation noise in amplifiers are described. These techniques include a.m. and f.m. direct-detection methods, the superheterodyne method, and systems for the measurement of correlation.

621.317.3.029.63: 621.391.822 **3503**

New Microwave Noise Generator for the 200-Mc/s Band.—G. Almássy & I. Frigyes. (*Period. polyt., Bp., Elect. Engng*, 1960, Vol. 4, No. 4, pp. 293–303.) Description of a small and easily operated microwave noise generator comprising a gas-discharge tube built into the inner conductor of a coaxial line. The output power depends exclusively on the noise temperature of the plasma.

621.317.337.029.6 **3504**

Measurement of Resonance Coefficients of the Order of a Million in the Microwave Field.—F. Parisi. (*Alta Frequenza*, Jan. 1961, Vol. 30, No. 1, pp. 14–20.) Equipment is described which is designed for Q-factor measurement in mm-λ H_{0n}-mode circular-waveguide systems; experimental results are given as examples.

621.317.35 **3505**

A Direct Digital Method of Power Spectrum Estimation.—P. D. Welch. (*IBM J. Res. Developm.*, April 1961, Vol. 5, No. 2, pp. 141–156.) A method is discussed for the estimation of a digital power spectrum which involves the direct combination of the sample time function with sines and cosines; practical design details are given.

621.317.36: 621.376.3 **3506**

Measurement of Frequency Deviation in F.M.—J. Marique. (*Rec. HF, Brussels*, 1961, Vol. 5, No. 1, pp. 1–12.) Two methods are described: one suitable only for symmetrically modulated waves, using a spectrum analyser, the other based on reconstructing the modulator signal and measuring its peak-to-peak value.

621.317.44 **3507**

Field Measurements by the Method of Harmonics: Angle Probes.—J. Greiner. (*Nachr Tech.*, Nov. 1960, Vol. 10, No. 11, pp. 495–498.) Description of various types of probe for magnetometer measurements using the method of perpendicularly superposed magnetic fields. See also 1608 of May and back references.

621.317.44 **3508**

Induction Probe with Microscope for the Measurement of Field-Strength Distribution in Magnetic Fields.—F. Graul. (*Nachr Tech.*, Nov. 1960, Vol. 10, No. 11, pp. 499–501.) The principle of operation is electrodynamic, indication being provided by the deflection of a current-carrying wire in the unknown magnetic field.

621.317.7: 621.382.3.001.4 **3509**

Pulse-Sampling Voltmeter and its Application to Transistor Testing.—L. J. Herbst & J. R. W. Smith. (*J. sci. Instrum.*, June 1961, Vol. 38, No. 6, pp. 242–245.) A 100-c/s signal is applied to the transistor under test and also to the voltmeter, which generates a 20-μs sampling pulse at the same frequency. The transistor output waveform can be examined at any phase in the cycle for voltages between 100 mV and 75 V. The sampled voltage is rectified and measured to an accuracy within 1%.

621.317.72: 621.319.4 **3510**

The Vibrating Capacitor, Theory and Application.—H. Riegler. (*Nachr Tech.*, Nov. 1960, Vol. 10, No. 11, pp. 501–505.) The design of vibrating capacitors for use in electrometer amplifiers is discussed.

621.317.755: 621.3.012.11 **3511**

A Circle-Diagram Recorder for Frequencies between 10 kc/s and 200-Mc/s.—P. Thilo. (*Frequenz*, Dec. 1960, Vol. 14, No. 12, pp. 403–412.) Description of equipment for the display of locus curves and diagrams of the Smith chart type on a c.r. tube screen.

621.317.755: 621.372.2.001.4 **3512**

Testing Microwave Transmission Lines using the Sampling Oscilloscope.—H. Halverson. (*Electronics*, 30th June 1961, Vol. 34, No. 26, pp. 86–88.) By using pulse reflection techniques and a c.r.o. with a fast rise time direct readings of characteristic impedance can be made. Discontinuities along the line can also be identified.

621.317.789.029.65 **3513**

100–200-kMc/s Water Calorimeter.—J. B. Thaxter & J. McGowan, III. (*Rev. sci. Instrum.*, May 1961, Vol. 32, No. 5, pp. 605–606.) The minimum detectable signal is 5×10^{-6} W with response time of 20 s, and sensitivity about 10 μV/mW. An important feature of the calorimeter is that heat losses from the water are nearly the same for the microwave and d.c. calibrating power sources.

621.317.79: 538.569.4: 535.33 **3514**

Sensitive Triple Modulation Method for Measuring Widths of Microwave Spectral Lines.—E. A. Ringhart & C. C. Lin. (*Rev. sci. Instrum.*, May 1961, Vol. 32, No. 5, pp. 562–563.) The method eliminates from the c.r.o. display the power fluctuations due to the klystron. The technique may be useful for resolving closely spaced lines.

621.317.79.029.64: 551.510.62 **3515**

The Construction and Performance of an Airborne Microwave Refractometer.—J. A. Lane, D. S. Froome & G. J. McConnell. (*Proc. Instn elect. Engrs*, Part B, July 1961, Vol. 108, No. 40, pp. 398–402.) "The paper describes the construction of a Birnbaum-type microwave refractometer and its application in studies of refractive-index variations at heights up to 20 000 ft. Practical problems encountered in airborne measurements are discussed in detail. Some typical results are given which illustrate the performance obtained in measurements of refractive-index profiles and discontinuities."

OTHER APPLICATIONS OF RADIO AND ELECTRONICS

621.362 + 621.56 **3516**

New Concepts in Thermoelectric Device Design.—W. H. Clingman. (*Proc. Inst. Radio Engrs*, July 1961, Vol. 49, No. 7, pp. 1155–1160.) Examples are given in which an analysis based on irreversible thermodynamics can be useful.

621.384.611.2 **3517**

The CERN 600-MeV Synchrocyclotron at Geneva.—(*Philips tech. Rev.*, 6th March 1961, Vol. 22, No. 5, pp. 141–180.)

Part 1—Object and Design.—W. Gentner (pp. 142–149).

Part 2—The Radio-Frequency System.—K. H. Schmitter & S. Kortleven (pp. 149–161).

Part 3—The Tuning-Fork Modulator.—B. Bollée & F. Krienen (pp. 162–180).

621.56: 537.322.1 **3518**

Peltier-Effect Cooling Blocks.—M. Fournet. (*Onde élect.*, Feb. 1961, Vol. 41, No. 407, pp. 140–141.) A note on the construction and characteristics of semiconductor thermoelements.

681.61 **3519**

Neon Diode Resistor Matrix controls Electronic Typewriter.—M. Ruderfer. (*Electronics*, 9th June 1961, Vol. 34, No. 23, pp. 108–109.) An improved printing mechanism is described using a printing type which is controlled by the matrix. This system allows faster operation, easy change of printing wheels and type faces and is of small and light construction.

PROPAGATION OF WAVES

621.371 **3520**

An Iteration-Variation Method for Wave Propagation Problems.—W. J. Byatt & G. P. DeVault. (*J. geophys. Res.*, June 1961, Vol. 66, No. 6, pp. 1795–1797.) An inhomogeneous wave equation in which

refractive index is a function of one space coordinate and time, is reduced to an ordinary differential equation by transform methods. An equivalent integral equation is formed with a symmetric kernel so that an iterative expansion has radius of convergence given by the numerical value of the smallest eigenvalue. A variational solution similar to the Rayleigh-Ritz method is given.

621.391.812.6.029.64/.65 **3521**

Microwave Absorption in the Earth's Atmosphere.—S. N. Ghosh & V. Malaviya. (*J. atmos. terr. Phys.*, July 1961, Vol. 21, No. 4, pp. 243–256.) The absorption for different atmospheric layers, and for the whole atmosphere, is calculated for frequencies between 10 and 100 Gc/s. The profiles and half-widths for principal absorption lines are given.

621.391.812.62 **3522**

Results and Evaluation of Measurements of Tropospheric Transhorizon Propagation over several Paths of Different Type in Central and South-East Europe.—H. Carl. (*Nachrichtentech. Z.*, Dec. 1960, Vol. 13, No. 12, pp. 566–570.) Results are given of measurements of transhorizon loss made on radio links of 230–400 km, some purely over land and others over sea, during periods of 4–6 weeks between February and May. The dependence of loss on elevation angle and dew point was in accordance with theory and some correlation with other meteorological conditions was found.

621.391.812.62.029.63 **3523**

Space-Diversity Measurements on a Radio-Link Path within Optical Range.—U. Kühn. (*NachrTech.*, Oct. 1960, Vol. 10, No. 10, pp. 430–435.) Measurements were made over a period of 21 months for transmissions at 1·3 Gc/s over an 82-km path with aerials vertically spaced by 250 λ. Long-term as well as short-term fluctuations are frequently reduced by the system. See also 1753 of 1960.

621.391.812.624: 621.396.677 **3524**

Tropospheric Scatter Observations at 3 480 Mc/s with Aerials of Variable Spacing.—R. W. Meadows. (*Proc. Instn elect. Engrs*, Part B, July 1961, Vol. 108, No. 40, pp. 349–360.) Measurements are described of signal amplitude, fading characteristics, correlation distances, and height gain at ranges of 130, 258 and 398 km in southern England, the 130-km path being largely over sea. Cross-correlation measurements showed definite evidence of the steady drifting of scattering centres.

621.391.812.63 **3525**

Scattering of Radio Waves by an Ionized Gas in Thermal Equilibrium in the Presence of a Uniform Magnetic Field.—J. A. Fejer. (*Canad. J. Phys.*, May 1961, Vol. 39, No. 5, pp. 716–740.) The earlier theory (1290 of April) was restricted to cases where the 'characteristic scale' was greater or less than the Debye length, and where only one type of singly charged ion was present. Ion and electron temperatures were assumed equal and the external field was ignored. These restrictions have now been removed. The total power is independent of the magnetic field and an expression for the frequency spectrum of the power in the presence of the field is given. The field may be ignored in interpreting the results of Bowles (*Phys. Rev. Lett.*, 15th Dec. 1958, Vol. 1, No. 12, pp. 454–455) and Pineo et al. (188 of January) but it could be important at great heights.

621.391.812.63 **3526**

Long-Distance One-Hop F_1 Propagation through the Auroral Zone.—L. H. Tveten. (*J. geophys. Res.*, June 1961, Vol. 66, No. 6, pp. 1683–1684.) "The existence of one-hop F_1 propagation through the auroral zone over a 4 495-km path is described, and an example of a sweep-frequency record *illustrating this F_1 mode is shown.*"

621.391.812.63: 551.507.362.2 : 621.396.43 **3527**

The Propagation of Wide-Band Signals through the Ionosphere.—Staras. (See 3537.)

621.391.812.63: 551.594.6 **3528**

Two-Hop 18·6-kc/s Whistler-Mode Echoes Received at Seattle.—H. R. Willard. (*J. geophys. Res.*, June 1961, Vol. 66, No. 6, pp. 1976–1977.) The observation of delay times ranging from 0·7 to 1·7 s suggests the existence of whistler propagation paths at quite different latitudes.

621.391.812.63.029.51 **3529**

A Diffraction Theory for L.F. Sky-Wave Propagation.—J. R. Wait. (*J. geophys. Res* , June 1961, Vol. 66, No. 6, pp. 1713–1724.) The propagation of radio waves via discrete ionospheric reflections is treated theoretically with the earth and the ionosphere represented by two concentric spherical surfaces of known reflection characteristics. The *m*th-hop sky-wave may generally be represented by a complex integral, and geometrical-optics formulae are developed for special cases and their limitations discussed. Techniques for evaluating the complex integral for sky waves near and beyond the caustics are discussed. For an additional note reporting some numerical results see *ibid.*, pp. 1725–1729 (Wait & Conda).

RECEPTION

621.391.814.2.029.53 **3530**

Temporal Variation of Medium-Frequency Ground-Wave Field Strength.—J. M. Dixon. (*Proc. Instn Radio Engrs, Aust.*, April 1961, Vol. 22, No. 4, pp. 250–252.) The results of field-strength measurements are analysed to show the variation to be expected under Australian conditions, with particular reference to path conductivity.

621.396.669–621.396.67 **3531**

The Suppression of Corona- and Precipitation-Interference in V.H.F. Reception.—H. Page. (*Proc. Instn elect. Engrs*, Part B, July 1961, Vol. 108, No. 40, pp. 469–470.) A note describing the results of preliminary tests on systems designed to screen television receiving aerials from such effects.

STATIONS AND COMMUNICATION SYSTEMS

621.376.5 **3532**

The Elimination of Intersymbol Interference by Input Signal Shaping.—I. Gerst & J. Diamond. (*Proc. Inst. Radio Engrs*, July 1961, Vol. 49, No. 7, pp. 1195–1203.) The problem is treated mathematically by considering the effect of the input wave shape on the output tail.

621.391 **3533**

Signal Detection and Establishment of the Mean Value in Periodic Signal Sequences with Superimposed Fluctuations.—C. Moeller. (*Hochfrequenztech. u. Elektroakust.*, Oct. 1960, Vol. 69, No. 5, pp. 189–192.)

621.391:534.78 **3534**

Bandwidth Compression of Speech.—Das. (See 3225.)

621.396: [523 + 55 **3535**

Radio Techniques and Space Research.—(See 3355.)

621.396.43: 551.507.362.2 **3536**

Economic Potential of Communication Satellites.—W. Meckling. (*Science*, 16th June 1961, Vol. 133, No. 3468, pp. 1885–1892.) Communication satellites may reduce costs if high rates of utilization can be achieved.

621.396.43: 551.507.362.2 : 621.391.812.63 **3537**

The Propagation of Wide-Band Signals through the Ionosphere.—H. Staras. (*Proc. Inst. Radio Engrs*, July 1961, Vol. 49, No. 7, p. 1211.) Differential group delay across the frequency band can cause distortion of television signals relayed by satellites. This distortion is strongly dependent on frequency and it may be necessary to use carriers in excess of 1 Gc/s.

621.396.65: 621.396.43 **3538**

Results and Experience Gained from a Transhorizon Link in the Long-Distance Communications Network of the German Federal Post Office.—E. Dietrich. (*Nachrichtentech. Z.*, Dec. 1960, Vol. 13, No. 12, pp. 563–565.) Report dealing with the Berlin–West Germany radio link operating at 2 Gc/s. See also 1635 of May (Hoffmann).

621.396.933 **3539**

Automatic Techniques in Civil Air Line Communication Systems.—W. E. Brunt. (*J. Brit. Instn Radio Engrs*, June 1961, Vol. 21, No. 6, pp. 549–553. Discussion, pp. 554–555.) Methods of modulation and coding are considered.

621.396.97: 534.76 **3540**

The H.M.D. System—a Method for the Transmission of Stereophonic Broadcasts.—E. Franck & J. Rauch. (*Elektronische Rundschau*, Nov. 1960, Vol. 14, No. 11, pp. 463–466.) Description of a single-carrier time-multiplex system using half-wave modulation with signal-difference control.

621.396.97 : 621.391.812.63 **3541**

An Investigation of the Usefulness of Back-Scatter Sounding in the Operation of H.F. Broadcast Services.—L. D. R. Shearman. (*Proc. Instn elect. Engrs*, Part B, July 1961, Vol. 108, No. 40, pp. 361–372. Discussion, pp. 372–374.) Echo patterns measured at 15 and 21 Mc/s agreed well with those calculated from parabolic-ionospheric-layer theory. Further tests, including listeners' reports, at night showed that propagation modes to 5 000 km were correctly evaluated, when predictions, corrected by local vertical-incidence soundings, gave erroneous results.

SUBSIDIARY APPARATUS

621–52 **3542**

Complex-Plane Charts for Obtaining Closed-Loop Frequency Responses in Linear Control Systems.—F. Csáki. (*Period. polyt., Bp., Elect. Engng*, 1960, Vol. 4, No. 4, pp. 361–378.) Summary of graphical methods for plotting complex-plane charts.

621.3.087.4 : 621.395.625.3 **3543**

Outside-Coil Magnetic Head Improves High-Frequency Recording.—M. Camras & R. Sears. (*Electronics*, 30th June 1961, Vol. 34, No. 26, pp. 89–91.) High resolution is obtained as a result of smaller air gaps and an improved field configuration.

621.314.58 **3544**

Replacing Sine-Wave Sources with Solid-State Inverters.—D. Levy. (*Electronics*, 30th June 1961, Vol. 34, No. 26, pp. 80–83.) A series magnetic amplifier or a saturable reactor is used following a solid-state inverter to give a modified square-wave output such that the heater and direct voltages available are the same as would be obtained from a sinusoidal a.c. supply.

621.314.58 : 621.382.23 **3545**

Converter Efficiency and Power Output of a Tunnel-Diode Relaxation Oscillator.—S. Wang. (*Proc. Inst. Radio Engrs*, July 1961, Vol. 49, No. 7, pp. 1219–1220.) A simple d.c.-a.c. converter is discussed.

621.314.58 : 621.382.3 **3546**

Control of Frequency and Phase Displacement in Transistor Converter Circuits by means of *RC* Networks.—F. V. Kadri. (*Commun. & Electronics*, March 1961, No. 53, pp. 43–48.) A new type of adjustable-frequency transistor converter is described in which the operating frequency is controlled by a *RC* network and is independent of the direct voltage. Power regulation by means of *RC* phase control of a pair of transistor converters is discussed.

621.314.63 : 621.374 **3547**

Controlled Rectifier Produces Quarter-Megawatt Pulse Power.—H. G. Heard. (*Electronics*, 23rd June 1961, Vol. 34, No. 25, pp. 50–55.) Circuit details are given of pulse generator equipment using solid-state devices as active elements. A *p-n-p-n* Si controlled rectifier acts as the switch, and two-layer and four-layer diodes are used in the trigger generator.

621.314.634 **3548**

Recent Developments in Selenium Rectifiers.—C. Loeffler. (*Onde élect.*, Feb. 1961, Vol. 41, No. 407, pp. 123–131.) An account of phenomena occurring during the construction and operation of different types of Se rectifier.

621.316.72 : 621.382.3 **3549**

A Note on Transistorized Ripple Filters.—B. W. Moore & J. P. O'Neil. (*A.W.A. tech. Rev.*, Dec. 1960, Vol. 11, No. 3, pp. 169–177.) A smoothing circuit providing optimum efficiency over a wide range of load currents is described.

TELEVISION AND PHOTOTELEGRAPHY

621.397.12 : 621.396.4 : 523.5 **3550**

Transmitting Facsimile Messages over Meteor-Burst Paths.—A. F. Gedaminski & W. F. Griffin, Jr. (*Electronics*, 19th May 1961, Vol. 34, No. 20, pp. 45–49.) Average information rate for 4-h periods was 2 300 bits/sec, in a 220 kc/s bandwidth.

621.397.13 **3551**

B.B.C. Television 1939–60.—E. L. E. Pawley. (*Proc. Instn elect. Engrs*, Part B, July 1961, Vol. 108, No. 40, pp. 375–397.) A comprehensive technical review of progress in planning and equipment.

621.397.13 (083.7) **3552**

I.R.E. Standards on Video Techniques: Definitions of Terms relating to Television, 1961.—(*Proc. Inst. Radio Engrs*, July 1961, Vol. 49, No. 7, pp. 1193–1195.) Standard 61 I.R.E. 23.S1.

621.397.132 **3553**

Land's System of Two-Colour Projection.—M. H. Wilson & R. W. Brocklebank. (*J. Brit. Instn Radio Engrs*, June 1961, Vol. 21, No. 6, pp. 535–536. Discussion, pp. 546–548.) A brief discussion of the physical principles involved.

621.397.132 **3554**

The Range of Colours Evoked by a Two-Colour Reproduction System.—W. N. Sproson. (*J. Brit. Instn Radio Engrs*, June 1961, Vol. 21, No. 6, pp. 537–544. Discussion, pp. 546–548.) An assessment of the accuracy with which colours can be reproduced relative to those of a three-colour system. The two-colour process is considered to be insufficient for a good approximation to true colour.

621.397.331.222 **3555**

Modifying Vidicon Camera Chain for Slow-Scan Television Systems.—F. F. Martin & C. T. Shelton. (*Electronics*, 9th June 1961, Vol. 34, No. 23, pp. 101–103.) In order to reduce bandwidth and transmitter power the use of low scan rates is discussed; further advantages are increased resolution, and more time available to interpret the scene. Disadvantages are microphonic signals due to vibration, and critical beam setting.

621.397.5.001.4 **3556**

A Television Imagery Simulator.—J. F. Smith & J. F. Baumunk. (*J. Soc. Mot. Pict. Telev. Engrs*, Jan. 1961, Vol. 70, No. 1, pp. 27–32.) A high-quality television chain suitable for testing television systems and providing means for comparing them.

621.397.61 : 621.029.63 **3557**

U.H.F. Television Techniques.—C. Reuber. (*Elektronik. Z., Edn B*, 20th March 1961, Vol. 13, No. 6, pp. 135–141.) Review of problems concerning transmitter-network planning, transmitter design, servicing aerials and aerial cables, and the design of u.h.f. tuners.

621.397.621 **3558**

Reflected Images on Curved and Plane Television-Tube Front Plates.—R. Subrmann. (*Elektronische Rundschau*, Nov. 1960, Vol. 14, No. 11, pp. 467–468.) The use of a flat, instead of a curved, safety-glass plate in front of television tubes minimizes interference by reflections particularly if the plate is inclined slightly downwards.

621.397.621 **3559**

Electronic Brightness Contouring.—R. L. Hallows. (*J. Soc. Mot. Pict. Telev. Engrs*, Jan. 1961, Vol. 70, No. 1, pp. 23–27.) A circuit technique is described for producing an "equal-brightness contour" which may be superimposed on a television picture and set to any level of brightness.

VALVES AND THERMIONICS

621.382.004.6 **3560**

Life Characteristics of some Typical Semiconductor Devices.—R. Bowers & D. J. E. Richards. (*J. Brit. Instn Radio Engrs*, June 1961, Vol. 21, No. 6, pp. 485–489.) Changes in characteristics after many thousands of hours in service, and the incidence of inoperative failures are discussed. Results from field reports and laboratory measurements are compared.

621.382.22 **3561**

Influence of Surface Currents on the Characteristics of Forward Point-Contact Rectifiers.—R. Eisbardt, E. Hofmeister & E. Groschwitz. (*Z. angew. Phys.*, Jan. 1961, Vol. 13, No. 1, pp. 16–20.) Results of measurements on point-contact semiconductor diodes are given and analysed with reference to previous theoretical work [3180 of September (Groschwitz et al.) and back references].

621.382.22 : 621.372.44 **3562**

High-Frequency Silicon Varactor Diodes.—C. A. Burrus. (*J. appl. Phys.*, June 1961, Vol. 32, No. 6, pp. 1160–1167.) By adopting point-contact diode geometry, Si varactor diodes with sub-cm-size junction

capacitances at least an order of magnitude below the minimum value associated with the Si mesa diode, have been made.

621.382.22:621.372.632 2161

Cavity Units in Microwave Wave Circuits.—R. G. Reich, W. A. Gambling & T. H. Willenbrock. (*Proc. Inst. Radio Engrs.*, July 1961, Vol. 49, No. 7, pp. 1220–1227.) Noise-temperature measurements have been made over a frequency range 27 c/s to 400 Mc/s.

621.382.23 2162

Tunnel-Effect Diodes.—R. Deschamps. (*Onde élect.*, Feb. 1961, Vol. 41, No. 407, pp. 132–139.) A description of the mechanism and characteristics of the tunnel diode. Optimum operating conditions are considered and possible applications are noted.

621.382.23 2163

The Technology of Tunnel Diodes.—H. J. Hartmann & M. Michelitsch. (*Elektrotech. Z., Edn A*, 15th Feb. 1961, Vol. 82, No. 4, pp. 114–116.) Types of construction and manufacturing techniques are discussed.

621.382.23 2164

Stability Criteria for Tunnel Diodes.—L. I. Smiley & D. C. Youla. (*Proc. Inst. Radio Engrs*, July 1961, Vol. 49, No. 7, pp. 1206–1207.) Various conditions for stability are stated and discussed.

621.382.23 2165

Electrical Characteristics of Diffused Si-As *p-n* Junctions.—G. Lucovsky. (*Brit. J. appl. Phys.*, June 1961, Vol. 12, No. 6, pp. 311–312.) Rectification properties are examined at 300 K, 196 K and 77 K. At 196 K, the *I-V* characteristic was in good agreement with conventional diode theory [e.g. 2906 of 1958 (Moll)]. Deviations noted at the other temperatures are accounted for.

621.382.23 2166

Gallium Arsenide Esaki Diodes for High-Frequency Applications.—C. A. Burrus. (*J. appl. Phys.*, June 1961, Vol. 32, No. 6, pp. 1031–1036.) "Esaki diodes which show promise of usefulness into the millimeter-wave region have been made from both *p*- and *n*-type GaAs. Both diodes were alloyed junctions having point-contact geometry and dimensions. The fabrication of these diodes is briefly described, and their initial performance as oscillators in mechanically simple circuits is discussed. Fundamental oscillations to 103 kMc/s have been obtained." See also 3188 of September.

621.382.23–621.372.44 2167

Circuit Control of Tunnel-Diode Negative-Resistance Characteristics.—W. N. Carr & A. G. Milnes. (*Proc. Inst. Radio Engrs*, July 1961, Vol. 49, No. 7, pp. 1208–1209.) Typical control circuits and characteristics are given.

621.382.23–621.374 2168

Application of Tunnel Diodes in Pulse Techniques.—C. L. Rohde & H. J. Thaler. (*Elektronik*, Feb. 1961, Vol. 10, No. 2, pp. 33–37.) Design procedure for multivibrator circuits are described.

621.382.23:621.375.9:621.372.44 2169

Resistance Diodes and their Application in Wide-Band Waveguide Amplifiers.—F. Bolinch & C. Sundhaus. (*Telefunken-Röhre*, Dec., 1960, No. 38, pp. 115–128.) Semiconductor resistance diodes with disk electrodes housed in a cartridge of greatly reduced size are used in the construction of a two-stage travelling-wave parametric amplifier for frequency range 2·7–2·9 Gc/s. The construction and performance of a frequency multiplier for use up to 6 Gc/s are also described.

621.382.233 2170

The *p-n-p-n* Diode.—M. Chappey. (*Onde élect.*, Feb. 1961, Vol. 41, No. 407, pp. 99–113.) The characteristics of the diode applicable to heavy-current uses, calculating machines or switching circuitry are discussed. An elementary theory of its operation and details of its production by double diffusion, simple diffusion, or alloying are given.

621.382.233:621.373.44 2171

Silicon Four-Layer Diodes as High-Power Pulse Generators.—R. P. F. Lander. (*Electronic Engng*, July 1961, Vol. 33, No. 401, pp. 426–431.) "Several circuits are presented showing that *p-n-p-n* devices in the two- or three-terminal configuration may be used as pulse generators delivering accurately rectangular power pulses for a variety of purposes including transmitters in the 20-kW peak input power region."

621.382.3 2172

Thermal Problems in Transistors.—H. J. Thurs. (*Elektronische Rundschau*, Jan. & Feb. 1961, Vol. 15, Nos. 1 & 2, pp. 15–18 & 61–65.) The problems reviewed include the dependence of transistor life on junction temperature, the calculation and measurement of internal thermal resistances, the measurement of heat interchange of cooling surfaces and the runaway effect and related stability criteria. 38 references.

621.382.3.001.4:621.317.7 2173

Pulse-Sampling Voltmeter and its Application to Transistor Testing.—Herbst & Smith. (See 3509.)

621.382.333.33 2174

The Calculation of Cut-Off Frequencies of Minority-Carrier Transport Factors in Drift Transistors when the Mobilities are not Constant.—T. Sugano & T. Kodaira. (*Proc. Inst. Radio Engrs*, July 1961, Vol. 49, No. 7, p. 1218.)

621.382.333.8 2175

The Field-Effect Tetrode.—H. A. Stone, Jr. & R. M. Warner, Jr. (*Proc. Inst. Radio Engrs*, July 1961, Vol. 49, No. 7, pp. 1170–1183.) The field-effect tetrode is described and its applications are discussed. The equations for its behaviour as a gyrator, an inductor, a negative resistance and an electronically variable resistor are developed.

621.382.333.8 2176

Construction of a New Tetrode Field-Effect Device: the Mistron.—J. Grosskopf. (*Onde élect.*, Feb. 1961, Vol. 41, No. 407, pp. 114–122.) A transistor field-effect device of annular construction is described. It contains a small control grid and a second larger grid which removes the dissipation power and modifies the equivalent circuit at high frequencies. It gives values beyond the limits suggested by Ebers & Moll [1240 of 1954]. See also 1670 of May (Martin).

621.383.032.217.2 2177

Gamma + Silver + Oxygen + Cesium Photocathode.—A. H. Sommer & W. E. Spicer. (*J. appl. Phys.*, June 1961, Vol. 32, No. 6, pp. 1036–1042.) Chemical and physical studies on the Ag-Ag$_2$O-Cs photocathode to gain an understanding of the chemical nature and the energy-band model of the material are reported.

621.383.032.217.2 2178

Measurement of the Partial Pressure of Cesium over Cesium Antimonide.—K. Miyake. (*J. appl. Phys.*, June 1961, Vol. 32, No. 6, pp. 1132–1136.)

621.385.032.213.1 2179

Electron Gun for the Generation of a Hollow Beam.—R. Jobst & W. Heuser. (*Telefunken-Röhre*, Dec., 1960, No. 38, pp. 99–114.) Design calculations for the electrodes of the gun are based on the assumption that the hollow beam can be regarded as a strip-beam system. Results obtained with an experimental gun confirm the validity of the assumption when the ratio of beam thickness to beam diameter is small.

621.385.3:.4].029.63 2180

New Ceramic Power Triodes and Tetrodes Operating at Very High Frequencies.—P. Gerlach. (*Onde élect.*, Feb. 1961, Vol. 41, No. 407, pp. 167–171.) Negative-grid valves are described which, when giving 10 kW c.w. power at 1 Gc/s, have an envelope temperature of several hundred °C.

621.385.4: 621.397.61 2181

Electron-Transit-Time Effects in Transmitter Tetrodes for Television Bands IV V.—W. Seiffarth. (*Arch. elekt. Übertragung*, Nov. 1960, Vol. 14, No. 11, pp. 491–498.) The method used by Hahner [3449 of 1955] for triodes is applied to high-power transmitter tetrodes for operation at 300 Mc/s. Problems of valve design are considered with reference to these calculations.

621.385.6 2182

An Approximation Method for the Determination of the Quadripole Characteristics of Electron Beams with the Aid of Elementary Functions.—K. O. Nielsen. (*Telefunken-Röhre*, Dec. 1960, No. 38, pp. 61–70.) The solution obtained for the quadripole parameters are given in graphical form. The method is applied to the study of the transformation region in a low-noise travelling-wave tube.

621.385.6: 621.396.615 2183

Microwave Valves for Radio-Link Systems.—W. Klein. (*Telefunken-Röhre*, Dec. 1960, No. 38, pp. 3–36.) The operation of the principal types of microwave valve is described and their performance in the local oscillator, microwave modulator and power amplifier stages is discussed.

621.385.62 **3586**

On the Possibility of Drift-Tunnel Oscillations in High-Power Klystrons.—K. Tomiyasu. (*Proc. Inst. Radio Engrs*, July 1961, Vol. 49, No. 7, pp. 1207–1208.) Spurious oscillations observed in high-power klystrons are discussed. The evidence which suggests they may be drift-tunnel oscillations is examined.

621.385.623.5 **3587**

Theory of Reflex Klystron with Inhomogeneous Retarding Field.—K. H. Kupferschmidt. (*Arch. elekt. Übertragung*, Nov. 1960, Vol. 14, No. 11, pp. 477–481.) The influence of the inhomogeneity on the build-up of oscillations and on the efficiency of the klystron is investigated. Measurements on a reflex klystron provide confirmation of the theoretical considerations.

621.385.623.5 **3588**

The Influence of Mechanical Vibrations on Reflex Klystrons.—P. Hain, H. Lind & W. Hennig. (*Telefunken-Röhre*, Dec. 1960, No. 38, pp. 135–150.) Methods are described for measuring the influence of sound and mechanical shock on the frequency stability of reflex klystrons. Results obtained on various klystrons are given and discussed.

621.385.623.5 **3589**

Electrically Tuned Klystron.—R. Musson-Genon & J. Faralier. (*Onde élect.*, Feb. 1961, Vol. 41, No. 407, pp. 155–158.) An X-band reflex klystron has been developed which is tuned electronically over a range of 300 Mc/s, the range being covered in approximately 200 μs.

621.385.63 **3590**

Tubes with Crossed Electric and Magnetic Fields.—P. Guénard & O. Doehler. (*Onde élect.*, Feb. 1961, Vol. 41, No. 407, pp. 142–154.) Various types of crossed-field tube are classified according to beam geometry and interaction mechanism. A description is given of results obtained with backward-wave oscillators and forward-wave amplifiers.

621.385.63 : 621.375.9 : 621.372.44 **3591**

Energy Interchange between Cyclotron and Synchronous Waves in Quadrupolar Pump Fields.—E. I. Gordon & A. Ashkin. (*J. appl. Phys.*, June 1961, Vol. 32, No. 6, pp. 1137–1144.) "The various coupling interactions which occur in quadrupolar pump fields have been described using a coupled-mode formalism and from knowledge of the beam orbits. Experiments have been described which verify the basic interactions. Further experimental work is required in order to assess the usefulness of these interactions in low-noise microwave amplification."

621.385.63 : 621.375.9 : 621.372.44 **3592**

Noise in Beam-Type Parametric Amplifiers.—E. I. Gordon. (*Proc. Inst. Radio Engrs*, July 1961, Vol. 49, No. 7, p. 1208.) Some additional noise which arises from the finite electron temperature and the size of the beams is discussed.

621.385.63 : 621.375.9 : 621.372.44 **3593**

Parametric Coupling between the Transverse Waves on O- and M-Type Beams.—J. W. Kluver. (*J. appl. Phys.*, June 1961, Vol. 32, No. 6, pp. 1111–1114.) To couple only two waves the pump field should be two-dimensional. For h.f. pumping only waves of the same polarization can couple while for l.f. pumping only two waves of opposite polarization can couple. Except for cyclotron-cyclotron wave coupling the pump wave will always be in synchronism with a beam wave and thus interact actively or passively with the beam.

621.385.63 : 621.375.9 : 621.372.44 **3594**

Transduction of Noise. Theory of a Generalized Travelling-Wave Coupler.—M. C. Pease. (*J. appl. Phys.*, June 1961, Vol. 32, No. 6, pp. 1145–1151.) A study is made of the response to noise of systems described as 'generalized lossless networks' which may include, for example, electron beams and parametrically pumped components. The theory is applied to a generalized coupler.

621.385.632.1 **3595**

The Uniformity of Active Lines for Microwaves.—W. Klein. (*Telefunken-Röhre*, Dec. 1960, No. 38, pp. 71–84.) Various influences affecting the uniformity of helix or delay-line structures in travelling-wave tubes are investigated.

621.385.633 **3596**

The Resonant-Type Backward-Wave Oscillator: a Generator of Microwaves.—H. Heynisch. (*Arch. elekt. Übertragung*, Dec. 1960, Vol. 14, No. 12, pp. 531–538.) The oscillator described differs from the normal type of backward-wave tube in that it uses the resonance effect produced by short-circuiting the delay line at both ends. The expressions giving the parameters of the normal backward-wave oscillator are modified by the introduction of the Q-factor of the short-circuited delay line to become applicable to the resonant type of oscillator. Experimental results are given for a resonant backward-wave tube operating in the range 3·5–4·7 Gc/s.

621.385.633.14 **3597**

O-Type Cavitrons Tubes and their Applications in V.H.F. Measurements.—R. Olivier & D. Reverdin. (*Elektronik Z., Edn. A*, 16th Jan. 1961, Vol. 82, No. 2, pp. 41–46.) Applications described include an u.h.f. wobbulator and a wide-band spectrum analyser.

621.385.65 **3598**

Design Aspects regarding Travelling-Wave Tubes with Tubular-Magnet Focusing for Radio-Link Applications.—W. Klein, J. Bretting & E. Mayerhofer. (*Telefunken-Röhre*, Dec. 1960, No. 38, pp. 85–90.) The use of straight-field focusing by means of barrel-shaped permanent magnets [see e.g. 3697 of 1957 (Glass)] is shown to be advantageous in respect of stray magnetic fields and of power-supply equipment.

621.387 **3599**

Relaxation Oscillations in a Plasma Diode.—J. M. Rocard & G. W. Paxton. (*J. appl. Phys.*, June 1961, Vol. 32, No. 6, pp. 1171–1172.) The dependence of the oscillation frequency on the various diode parameters is investigated.

621.387.132.223 : 621.376.5 **3600**

Measurement of Energy Losses in a Hydrogen-Filled Thyratron in Modulator Duty.—H. de B. Knight & J. Lord. (*Proc. Instn elect. Engrs*, Part B, July 1961, Vol. 108, No. 40, pp. 455–464.) Values of dissipation at the leading and trailing edges of a current pulse and during the steady state are separated by a pulse-chopping process.

MISCELLANEOUS

061.4 : 621.38.002.3 **3601**

Radio Components Show.—(*Wireless World*, July 1961, Vol. 67, No. 7, pp. 361–367.) Review of new equipment and developments exhibited at the Radio and Electronic Components Show, London, 30th May–2nd June 1961.

061.4 : 621.39 **3602**

Soviet Exhibition in London.—(*Wireless World*, Aug. 1961, Vol. 67, No. 8, pp. 398–399.) Specifications are given of some of the industrial and domestic equipment which was displayed at Earls Court, London.

Abstracts and References

COMPILED BY THE RADIO RESEARCH ORGANIZATION OF THE DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH AND PUBLISHED BY ARRANGEMENT WITH THAT DEPARTMENT

The abstracts are classified in accordance with the Universal Decimal Classification. They are arranged within broad subject sections in the order of the U.D.C. numbers, except that entries of book reviews are placed at the ends of the sections. U.D.C. numbers marked with a dagger (†) must be regarded as provisional. The abbreviations of journal titles conform generally with the style of the World List of Scientific Periodicals. An Author and Subject Index to the abstracts is published annually; it includes a list of journals abstracted, the abbreviations of their titles and their publishers' addresses. Copies of articles or journals referred to are not available from Electronic Technology. Application must be made to the individual publishers concerned.

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ACOUSTICS AND AUDIO FREQUENCIES

534.152 **3603**

Optical Calibration of Vibration Pickups at Small Amplitudes.—V. A. Schmidt, S. Edelman, E. R. Smith & E. Jones. (*J. acoust. Soc. Amer.*, June 1961, Vol. 33, No. 6, pp. 748–751.) A photometric device based on a Fizeau-type interferometer is described, capable of measuring sinusoidal variations ranging from 72 to 4 400 Å in amplitude.

534.2 : 534.88 **3604**

Horizontal Refraction in a Three-Dimensional Medium of Variable Stratification.—D. E. Weston. (*Proc. phys. Soc.*, 1st July 1961, Vol. 78, No. 499, pp. 46–52.) The bending of rays caused by reflection at an inclined boundary is discussed, with reference to underwater propagation of sound. See also 2204 of 1959.

534.2-14 **3605**

The Propagation of Tone Signals in a Plane Water Layer with Agitated Surface.—L. N. Zakharov. (*Akust. Zh.*, 1960, Vol. 6, No. 4, pp. 454–461.) Investigation of the effect of surface agitation on signal amplitude and phase difference. Quantitative correlations are obtained between the fluctuation of the acoustic signal and height of the surface wave.

534.2-14 **3606**

The Fluctuations of Underwater Acoustic Signals Reflected from a Rough Sea Surface.—G. E. Smirnov & O. S. Tonakanov. (*Akust. Zh.*, 1960, Vol. 6, No. 4, pp. 482–490.) Experiments were carried out in natural conditions and in a model tank at frequencies of 5–25 kc/s and 70–200 kc/s respectively. A factor is derived for the amplitude variation and the magnitude of fluctuation of the phase difference of reflected signals corresponding to different values of the roughness coefficient of the water surface.

534.21 **3607**

Experimental Study of the Influence of Surface Finish on Attenuation of Surface Waves.—N. S. Bykov & Yu. G. Shneider. (*Akust. Zh.*, 1960, Vol. 6, No. 4, pp. 501–503.)

534.232 **3608**

Computation of Axial Concentration Coefficient of certain Discrete Receiving-Radiating Groups.—R. V. Belyakov. (*Akust. Zh.*, 1960, Vol. 6, No. 4, pp. 499–501.)

534.232 : 538.652 **3609**

Utilization of Magnetostrictive Materials in Generating Intense Sound.—R. R. Whymark. (*J. acoust. Soc. Amer.*, June 1961, Vol. 33, No. 6, pp. 725–732.) The calculated and theoretical sound outputs of a laminated bar of annealed Ni at its resonance frequency agree within ±10%. The bar, resonant longitudinally at 20 kc/s, gave a measured maximum sound intensity of 167 W/cm².

534.232 : 621.316.825 **3610**

Thermoelectric Ultrasonic Pickup with a Semiconductor Thermistor.—E. K. Labartkava. (*Akust. Zh.*, 1960, Vol. 6, No. 4, pp. 468–471.) Brief description of a point-type transducer consisting of a microthermoresistor with a plexiglass thermosensitizer.

534.232.089.6 **3611**

Acoustic Measurements under Transient Temperature Conditions.—W. L. Paine. (*J. acoust. Soc. Amer.*, June 1961, Vol. 33, No. 6, p. 816.) A transducer to be calibrated is precooled or warmed to the temperature extreme of interest and its performance is then monitored as it returns to the ambient temperature of the water in an anechoic test tank.

534.283-8 : 537.311.31 **3612**

Dynamical Theory of Ultrasonic Attenuation in Metals.—N. Takimoto. (*Progr. theor. Phys.*, March 1961, Vol. 25, No. 3, pp. 327–352.) A detailed investigation of the ultrasonic attenuation governed by the dynamic properties of conduction electrons.

534.522.1 **3613**

Optical Measurement of Ultrasonic Fields.—R. F. Weeks. (*J. acoust. Soc. Amer.*, June 1961, Vol. 33, No. 6, pp. 741–747.) Passage of an ultrasonic wave train through a transparent solid produces a periodic birefringence within the solid. A photomultiplier scans the transmitted light mechanically to determine sound energy flow in the solid.

534.62 **3614**

Acoustic Properties of Anechoic Chamber.—N. Olson. (*J. acoust. Soc. Amer.*, June 1961, Vol. 33, No. 6, pp. 767–770.) Results of measurements made in a chamber built for the National Research Council of Canada are given in graphical form.

534.88 : 621.396.965.4 **3615**

Multiplicative Receiving Arrays: the Angular Resolution of Targets in a Sonar System with Electronic Scanning.—V. G. Welsby. (*J. Brit. Instn Radio Engrs*, July 1961, Vol. 22, No. 1, pp. 5–12.) A theoretical analysis of the effect of cross-product terms on the performance of a multiplicative system is given. Results of practical trials confirm that the system can give an angular resolution approximately twice as good as that of the same system additively.

621.395.625.3 : 681.84.083.84 **3616**

The Modulation Noise [illegible]etic Recording Tape.—P. A. [illegible] (*Arch. elekt. Übertragung*, Jan. 1961, Vol. [illegible]5, No. 1, pp. 18–24.) With reference to earlier investigations on unused and erased tape (3385 of 1957) the effect of modulation on tape noise is calculated for sinusoidal and pulse modulation. The spectral distribution of noise power is found to be independent of signal frequency.

681.828.5 **3617**

Electronic Generation of Sounds using the Principle of Light-Spot Scanning of Stencils.—G. Holoch. (*Nachrichtentech. Z.*, Jan. 1961, Vol. 14, No. 1, pp. 1–6.) Method and equipment are described for the production of pure and mixed sounds with dynamic structure of almost any desired rate of variation.

AERIALS AND TRANSMISSION LINES

621.315.212 **3618**

Temperature Variation of Primary and Secondary Parameters of 2·6/9·5 mm Coaxial Pairs.—A. Payant. (*Câbles & Transm.*, April 1961, Vol. 15, No. 2, pp. 130–147.) A theoretical and experimental study with reference to the experimental Corbeil-Versailles link.

621.315.212 : 621.372.51 **3619**

Physically Short High-Power Balun is Continuously Variable.—J. T. Coleman. (*Electronics*, 28th July 1961, Vol. 34, No. 30, pp. 50–52.) A coaxial-line capacitively loaded balun for 5 MW at 10–30 Mc/s having a physical length $< \lambda/20$ and using vacuum variable capacitors is described.

621.372.2 : 621.371 **3620**

Transmission-Line Model.—J. D. Wallace. (*Proc. Inst. Radio Engrs*, Aug. 1961, Vol. 49, No. 8, p. 1324.) A hypothetical infinitely long coaxial line with zero-loss conductors having a ratio between the inner diameter of the outer conductor and the outer diameter of the inner conductor equal to $e^{2\pi}$, when used in a vacuum, can be shown to have the same properties as free space. The line formulae enable various propagation problems to be simulated. Examples are given.

621.372.2 : [621.372.51 + 621.372.814 **3621**

The Design of n-Step Line Transformers.—H. Schreiber. (*Arch. elekt. Übertragung*, Feb. 1961, Vol. 15, No. 2, pp. 84–90.) Design formulae are derived for noncompensated matching transformers consisting of n sections of homogeneous transmission line. Design methods are compared.

621.372.2 : 621.372.512 **3622**

High-Speed Microwave Switch.—L. L. Oh & C. D. Lunden (*Electronics*, 7th July 1961, Vol. 34, No. 27, p. 60.) A noncontacting rotary switch using straight-line and circular-line codirectional couplers for sampling the power in a 24-element linear aerial array is described. It scans at rates up to 5 000 rev/min and has a power-coupling efficiency of 80% at 430 Mc/s.

621.372.2 : 621.372.512 **3623**

Zigzag-Line Couplers transfer Microwave Power.—L. L. Oh & C. D. Lunden. (*Electronics*, 14th July 1961, Vol. 34, No. 28, pp. 58–59.) Brief details are given of several u.h.f. switches using a zigzag line as the coupling element. An almost constant input impedance is maintained during switching and several advantages, due to the absence of arcing and mechanical contacts, are obtained over conventional switching devices.

621.372.8 : 537.56 **3624**

Propagation of Centimetre Waves through Waveguides Filled with Plasma of the Positive Column of a Discharge: Part 1.—V. E. Golant, A. P. Zhilinskil, M. V. Krivosheev & G. P. Nekrutkina. (*Zh. tekh. Fiz.*, Jan. 1961, Vol. 31, No. 1, pp. 55–62.) Results of an experimental investigation are compared with theoretical data.

621.372.8 : 537.56 **3625**

Propagation of Centimetre Waves through Waveguides Filled with Plasma of the Positive Column of a Discharge: Part 2.—V. E. Golant, A. P. Zhilinskil, M. V. Krivosheev & L. I. Chernova. (*Zh. tekh. Fiz.*, Jan. 1961, Vol. 31, No. 1, pp. 63–70.) Results are given of an experimental investigation of the dependence of the wave propagation constant on the high-frequency field strength, for regions in which nonlinear effects occur. Part 1 : 3624 above.

621.372.8.09 **3626**

The Influence of Parasitic Parameters of an Electrical Waveguide Model on the Accuracy of the Solution of the Problem of Field Distribution.—N. I. Sinelo. (*Radiotekhnika i Elektronika*, Sept. 1960, Vol. 5, No. 9, pp. 1417–1425.)

621.372.81 **3627**

Wave Parameters and Wave Matrices Particularly for Microwave Networks with Multimode Waveguide.—H. Brand. (*Arch. elekt. Übertragung*, Jan. 1961, Vol. 15, No. 1, pp. 48–60.) The relation between vector field quantities and the scalar wave parameters in waveguide networks is analysed for several types of mode. The use of scattering and transmission matrices for calculations on multimode waveguide systems is described with examples.

621.372.829 : 621.372.853.2 **3628**

Propagation of Electromagnetic Waves in Waveguides of Complex Cross-Section with a Cross-Magnetized Ferrite Plate.—N. M. Kovtun. (*Radiotekhnika i Elektronika*, Sept. 1960, Vol. 5, No. 9, pp. 1426–1430.) Equations are derived defining the propagation constants of a ferrite-loaded waveguide of H-shape cross-section and variants of this.

621.372.832 **3629**

Electromagnetic Waves in Multiterminal Couplings of Rectangular Waveguide.—H. Kaden. (*Arch. elekt. Übertragung*, Feb. 1961, Vol. 15, No. 2, pp. 61–70.) The distribution of H_{01}-mode power at a transition from two parallel waveguides to a single waveguide of double width is considered, and the problem is formulated mathematically by an infinite set of linear equations which is solved approximately by computer. The coupling between two parallel rectangular waveguides coupled by a slot of arbitrary length is calculated and the special case of equal distribution of power in the two waveguide sections is discussed.

621.372.837.1 **3630**

Waveguide Switch for Microwave Radiometers.—M. J. B. Scanlan. (*Electronic Technol.*, Sept. 1961, Vol. 38, No. 9, pp. 337–339.) The switch, especially useful for large waveguides, is based on the short-slot or Riblet coupler and operates in the range 1–2 Gc/s. A vane, rotating at half the switching frequency, opens and closes the waveguides joining the two couplers.

621.372.852 : 621.318.134 **3631**

Low-Level Garnet Limiters.—F. R. Arams, M. Grace & S. Okwit. (*Proc. Inst. Radio Engrs*, Aug. 1961, Vol. 49, No. 8, pp. 1308–1313.) S- and L-band low-level passive limiters using polished single crystals of narrow-line-width Y-Fe garnet have been developed. Performance data are given. The operation of three novel types of limiter—electronically tunable preselectors and cavity-type and comb-type filters—is described.

621.396.67 **3632**

The Antenna Constructed by Parallel Wires.—K. Nagai, R. Sato & H. Uchida. (*Sci. Rep. Res. Inst. Tohoku Univ., Ser. B*, 1960, Vol. 12, No. 2, pp. 73–96.) The interchange between normal-phase modes and the zero-phase modes in the case of two asymmetrical or discontinuous parallel wires is considered. The theory developed is applied to radiating systems.

621.396.67 : 621.397.62 **3633**

The Permissible Mismatch in Aerial Installations for Television Reception.—Fichtenz. (See 3955.)

621.396.67.09 **3634**

Current Waves in a Thin Cylindrical Conductor: Part 3—Variational Method and its Application to the Theory of an Ideal Conductor and a Conductor with Impedance.—L. A. Vainshtein. (*Zh. tekh. Fiz.*, Jan. 1961, Vol. 31, No. 1, pp. 79–94.) A method of successive approximations is described based on the variational principle. This technique permits a derivation of an expression for waves in thin conductors. An approximate expression is also obtained for

the scattering characteristic of a plane e.m. wave on a semi-infinite conductor. Part 2: 4104 of 1960.

621.396.67.095 **3635**

Current Waves in a Thin Cylindrical Conductor: Part 4—Input Impedance of an Oscillator and the Accuracy of Formulae.—L. A. Vaĭnshteĭn. (*Zh. tekh. Fiz.*, Jan. 1961, Vol. 31, No. 1, pp. 45–50.) Values of the complex variable determining the input impedance of an infinite conductor are tabulated, and the significance of this parameter in calculating the impedance of a straight conductor of finite length is clarified. Part 3: 3634 above.

621.396.674.3 **3636**

The Electromagnetic Fields of a Horizontal Dipole in the Presence of a Conducting Half-Space.—J. R. Wait. (*Canad. J. Phys.*, July 1961, Vol. 39, No. 7, pp. 1017–1028.) Fairly simple expressions for the fields are obtained by three methods and adequately cover all distances.

621.396.676: 551.507.362.2 **3637**

Reconnaissance Satellite Antennas.—R. B. MacAskill. (*Electronic Ind.*, April 1961, Vol. 20, No. 4, pp. 108–115.) Design problems relating to gain, bandwidth and directivity requirements are discussed. Signal resolving techniques and possible types of aerial are outlined.

621.396.677 **3638**

Circular Aerial Arrays for Radio Astronomy.—J. P. Wild. (*Proc. roy. Soc. A*, 13th June 1961, Vol. 262, No. 1308, pp. 84–99.) A theoretical analysis shows that a circular array has a number of advantages over the Mills cross: (*a*) the length of transmission line between each element and receiver is halved; (*b*) for the same information, the number of elements required is reduced in the ratio $4:\pi$; (*c*) the beam possesses circular or elliptical symmetry, and (*d*) the system can be calibrated directly for phase and amplitude using a transmitter on a central tower.

621.396.677: 623-526 **3639**

Project Echo: Antenna Steering System.—Killian, Newton & Gotheim. (See 2937.)

621.396.677.01 **3640**

Maximum Antenna Gain of Skewed Beams.—D. Levine. (*J. Franklin Inst.*, March 1961, Vol. 271, No. 3, pp. 188–196.) The maximum gain of narrow beams can be evaluated within 1 dB if it is assumed that 60% of the transmitted energy lies outside the 3-dB power contour. If the computed gain exceeds the measured value by more than 1 dB, it is probable that the design can be improved.

621.396.677.3 **3641**

The Theory of a Single-Ring Circular Antenna Array.—C. E. Hickman, H. P. Neff & J. D. Tillman. (*Commun. & Electronics*, May 1961, No. 38, pp. 109–115.) An examination is made of the currents possible in a circular array, the patterns which results from them, and means of producing a specific radiation pattern.

621.396.677.3 **3642**

Resolution Characteristics of Correlation Arrays.—I. W. Linder. (*J. Res. nat. Bur. Stand.*, May/June 1961, Vol. 65D, No. 3, pp. 245–252.) Analysis of resolution capabilities of correlation arrays shows a marked change in performance in the presence of two or more signal sources. These effects are analysed for single-frequency signal sources and for randomly varying signal sources. Under optimum conditions a correlation array has twice the directivity of a linear array of the same length.

621.396.677.73 **3643**

A Method of Determining Phase Centres and its Application to Electromagnetic Horns.—Y. Y. Hu. (*J. Franklin Inst.*, Jan. 1961, Vol. 271, No. 1, pp. 31–39.) The centre of a radiating system may be located from the expression for the radiating field. The method is applied to e.m. horns of different dimensions and flare angles.

621.396.677.833 **3644**

The Radiation of a Reflector Aerial in the Shadow Region.—V. L. Tandit & L. B. Tartakovskiĭ. (*Radiotekhnika i Elektronika*, Sept. 1960, Vol. 5, No. 9, pp. 1398–1406.) The radiation field in the shadow region of an infinitely thin, ideally conducting reflector irradiated by a small wide-beam exciter is calculated, taking account of diffraction corrections for the near field of the exciter, the curvature of the reflector, and fringe effects.

621.396.677.833.2 **3645**

The Condition of Shadowing and the Diffraction Correction to Current Distribution.—B. E. Kinber. (*Radiotekhnika i Elektronika*, Sept. 1960, Vol. 5, No. 9, pp. 1407–1416.) Theoretical treatment relating to the diffraction field of a paraboloidal radiator.

621.396.677.833.2 **3646**

Project Echo: a Horn-Reflector Antenna for Space Communication.—A. B. Crawford, D. C. Hogg & L. E. Hunt. (*Bell Syst. tech. J.*, July 1961, Vol. 40, No. 4, pp. 1095–1116.) The mechanical construction and electrical properties are described. Gain and pattern measurements at 2 390 Mc/s agree well with the theoretical characteristics.

621.396.677.833.2: 621.396.93 **3647**

Design of Line Feed for World's Largest Aperture Antenna.—A. F. Kay. (*Electronics*, 7th July 1961, Vol. 34, No. 27, pp. 46–47.) A description of the design of the feed system for the 1 000-ft spherical dish aerial being erected at Arecibo, Puerto Rico.

AUTOMATIC COMPUTERS

681.142 **3648**

Digital Computers.—K. Mierzewski. (*VDI Z.*, 11th June 1961, Vol. 103, No. 17, pp. 767–775, 4 tables.) Annual review of developments in computer design with descriptions of recent installations and tabulated performance data. 76 references. For previous review see 3381 of 1960 (Schuff).

681.142? **3649**

Notes on the Structure of Logic Nets.—R. M. Stewart. (*Proc. Inst. Radio Engrs*, Aug. 1961, Vol. 49, No. 8, pp. 1322–1323.) An elementary approach to a theory of the role of structure in logic nets.

681.142 **3650**

The Main Store of a Digital Differential Analyser.—P. L. Owen, M. F. Partridge & T. R. H. Sizer. (*Electronic Engng*, Aug. 1961, Vol. 33, No. 402, pp. 514–520.) A description of the performance and circuits of the main store of CORSAIR.

681.142: 621.3.029.6 **3651**

A Potential Microwave Computer Element.—R. W. Couch, A. F. Rashid & R. Spence. (*Proc. Inst. Radio Engrs*, Aug. 1961, Vol. 49, No. 8, pp. 1338–1339.) A bistable-oscillator frequency-script system is described which uses a tunnel diode as the active element. A switching time of the order of 10 cycles is required for resonance frequencies of 600/735 kc/s. Operation at 250/375 Mc/s has been demonstrated, and operation at 10 Gc/s is suggested.

CIRCUITS AND CIRCUIT ELEMENTS

621.316.825 **3652**

New, Thermally Variable Bead Resistor.—V. J. Tennery & R. G. West. (*J. appl. Phys.*, July 1961, Vol. 32, No. 7, p. 1402.) The unique *I-V* characteristic of ion-doped $BaTiO_3$ is illustrated. A bead 0·075 in. in diameter dissipated 1·5 W in still air.

621.318.4: 621.3.011.4 **3653**

Equivalent Circuits of Coils with Distributed Capacitances.—A. Ferrero. (*Rec. IEE, Brussels*, 1961, Vol. 3, No. 2, pp. 19–25.) The equivalent circuit comprises an ideal coil, a certain number of positive capacitances (two in the case of a coil with one winding) and an additional capacitance which can be either positive or negative depending on the relative magnitude and the exact distribution of the various parasitic capacitances.

621.318.4.042: 621.375.3 **3654**

On the Core Gain of the Magnetic Amplifier Cores.—K. Murakami & T. Sakuchi. (*Sci. Rep. Res. Inst. Tohoku Univ., Ser. B*, 1960, Vol. 12, No. 2, pp. 135–144.) New definitions, specific core gain and core gain, are suggested and the relation of these to the power gain of an amplifier is discussed.

621.318.435 **3655**

An Experimental Study on the Sensitive-Time Gain of Ordinary Saturable Reactors.—W. A. Geyger. (*Commun. & Electronics*, May 1961, No. 38, pp. 173–178.) Measurements show that great

improvements in performance of d.c. instrument transformers can be obtained by slightly increasing the effective ratio of primary to secondary turns and applying a properly rated a.c. bias circuit.

621.318.57 : 537.312.62 **3656**

On the Linear Circuit Aspects of Cryotrons.—P. M. Chirlian & V. A. Marsocci. (*Proc. Inst. Radio Engrs*, Aug. 1961, Vol. 49, No. 8, p. 1326.) An expression is derived for the gate resistance of a cryotron in the transition region.

621.318.57 : 621.317.6 **3657**

Variable-Conductance Sampling Switch.—J. E. Taylor. (*Rev. sci. Instrum.*, June 1961, Vol. 32, No. 6, pp. 754–755.) Weighted sums are produced of discrete samples from continuous voltage waveforms, by varying the rate at which the integrating capacitor can charge. The switch has been operated randomly and cyclically at rates between 20 and 50 000/sec.

621.318.57 : 621.382.23 **3658**

The Silicon Cryosar.—H. Izumi. (*Proc. Inst. Radio Engrs*, Aug. 1961, Vol. 49, No. 8, pp. 1313–1314.) The main difference from the Ge cryosar [3211 of 1959 (McWhorter & Rediker)] is that negative-resistance characteristics are obtained using crystals with uncompensated impurities. As a computer element the device has been switched in about 50 ns and has a maximum/minimum voltage ratio as high as 7.

621.319.4 : 621.372.44 : 621.382 (083.7) **3659**

I.R.E. Standards on Solid-State Devices: Definitions of Terms for Nonlinear Capacitors, 1961.—(*Proc. Inst. Radio Engrs*, Aug. 1961, Vol. 49, No. 8, pp. 1279–1280.) Standard 61 I.R.E. 28.S1.

621.372.44 : 621.373 **3660**

On Some Aspects of Matrix Calculus applied to Local Oscillation in Nonlinear Circuits.—F. Bertein. (*J. Phys. Radium*, Nov. 1960, Vol. 21, Supplement to No. 11, *Phys. appl.*, pp. 137A–148A.) The application of matrix methods to the analysis of oscillating circuits with an impressed signal of low amplitude is considered. The representation of amplitude and phase modulation in co-ordinate form is illustrated, and examples are given of the use of these methods in problems of oscillator stabilization.

621.372.5 : 517.7 **3661**

Elliptic Functions in Network Synthesis.—S. D. Bedrosian. (*J. Franklin Inst.*, Jan. 1961, Vol. 271, No. 1, pp. 12–30.) The Jacobian elliptic functions are used to solve the approximation problem of network synthesis. A unified design chart for image-parameter filters, elliptic-function filters and 90°-phase-difference networks is shown and tabular and graphical data emphasizing extreme parameter values are given.

621.372.5 : 621.3.049.75 **3662**

Shaping of Distributed *RC* Networks.—B. L. H. Wilson & R. B. Wilson. (*Proc. Inst. Radio Engrs*, Aug. 1961, Vol. 49, No. 8, pp. 1330–1331.) An improvement in the attenuation factor of a 180°-phase-shift network from 29 to 7 appears to be possible if the conventional untapered 3-section network is replaced by a tapered distributed network.

621.372.54 **3663**

Graphical Procedures for Solving the Approximation Problem of Electrical Filters.—R. Rubini. (*Alta Frequenza*, Feb. 1961, Vol. 30, No. 2, pp. 135–155.) Three graphical methods of synthesizing filter response characteristics as the sum and difference of functions of similar geometric form are explained. The methods are theoretically equivalent but have different fields of application. For English version see *ibid.*, March 1961, Vol. 30, No. 3, pp. 188–215.

621.372.54 : 621.372.412 **3664**

Optimum Matching of Symmetrical Low-Pass and High-Pass Filters: Application to Low-Pass and High-Pass Ladder Filters using Piezoelectric Crystals.—J. E. Colin & P. Allemandou. (*Câbles & Transm.*, April 1961, Vol. 15, No. 2, pp. 99–114.) A filter structure is suggested which is especially suitable for use with crystal elements. Advantages and disadvantages of this and similar structures are discussed.

621.372.543.2 **3665**

Tunable Rejection Filters.—L. A. Moxon. (*Electronic Technol.*, Sept. 1961, Vol. 38, No. 9, pp. 327–330.) An analysis of the requirements for a rejection filter is used in the design of some practical circuits, tunable over half an octave and covering the h.f. band.

621.372.55 : 621.396.4 : 621.376 **3666**

V.H.F. Broad-Band Variable Group-Delay Equalizers.—R. Hamer & R. G. Wilkinson. (*Electronic Engng*, Aug. 1961, Vol. 33, No. 402, pp. 506–510.) The two designs described are for links using (*a*) 960 telephony channels or 405-line subcarrier colour television, (*b*) 1 800 telephony channels or 625-line subcarrier colour television.

621.372.6 **3667**

Application of Graph Theory to the Analysis of Active and Mutually Coupled Networks.—W. H. Kim. (*J. Franklin Inst.*, March 1961, Vol. 271, No. 3, pp. 200–221.) A unified graphical approach applying the concept of the mathematically equivalent circuit [52 of 1956 (Percival)] as it relates to the indefinite admittance matrix of a multipole.

621.372.632 : 621.382.23 **3668**

Stable Low-Noise Tunnel-Diode Frequency Converter.—F. Sterzer & A. Presser. (*Proc. Inst. Radio Engrs*, Aug. 1961, Vol. 49, No. 8, p. 1318.) An initial wide-band converter with local-oscillator frequency 780 Mc/s and intermediate frequency 30 Mc/s had unity conversion gain and a radiometer noise figure of 2·5 dB.

621.373 : 621.372.2 : 621.372.44 **3669**

Self-Oscillation in a Transmission Line with a Tunnel Diode.—J. Nagumo & M. Shimura. (*Proc. Inst. Radio Engrs*, Aug. 1961, Vol. 49, No. 8, pp. 1281–1291.) A theoretical analysis of the circuit is given together with experimental results. The self-oscillation can be explained as a periodic solution of the linear wave equation with a nonlinear boundary condition.

621.373 : 621.391.822 **3670**

Broadening of the Spectrum of an Oscillator due to Noise.—J. Loch. (*Ann. Télécomm.*, May/June 1959, Vol. 14, Nos. 5/6, pp. 151–152.) A formula is derived for the frequency broadening due to random thermal noise in a nonlinear circuit.

621.373.4 **3671**

Pulling Phenomena in Valve Oscillators.—S. Spiess. (*NachrTech.*, Oct. & Dec. 1960, Vol. 10, Nos. 10 & 12, pp. 452–457 & 540–546.) A general theory of pulling effects is derived on the basis of band-filter theory. These effects are calculated as a function of detuning and degree of coupling between similar and dissimilar oscillator circuits. A mechanical analogue of a 'pulled' oscillating system is described.

621.373.4.029.4 : 621.316.86 **3672**

Varistor Network controls Voltage-Tuned Oscillator.—M. Uno. (*Electronics*, 28th July 1961, Vol. 34, No. 30, pp. 44–47.) An a.f. phase-shift oscillator, with SiC varistors as the variable elements has almost constant output over a range of 10 : 1 and low harmonic distortion.

621.373.421.11 **3673**

Locking of a Two-Circuit Oscillator.—G. D. Shemanaev & E. N. Ivanova. (*Radiotekhnika i Elektronika*, Sept. 1960, Vol. 5, No. 9, pp. 1387–1397.) The addition of a second tuned circuit improves the amplitude/frequency and phase/frequency characteristics of a locked oscillator. The effect of coupling conditions on stability is discussed.

621.373.421.13 **3674**

Recent Development of Quartz Crystal Units for Telecommunication.—K. Takahara. (*Rev. elect. Commun. Lab., Japan*, March/April 1961, Vol. 9, Nos. 3/4, pp. 165–206.) A new method and equipment devised for manufacture and development of crystal units in the range 1 kc/s–100 Mc/s, and associated apparatus are described.

621.373.43 : 621.382.23 **3675**

Tunnel-Diode One-Shot and Triggered Oscillator.—T. W. Flowerday & D. D. McKibbin. (*Proc. Inst. Radio Engrs*, Aug. 1961, Vol. 49, No. 8, p. 1315.) The one-tunnel-diode flip-flop described by Kaenel (1761 of June) which requires a bidirectional pulse can be made to operate as a triggered oscillator by the addition of an identical circuit with modified bias.

621.373.43 : 621.382.3 **3676**

The Switching Mechanism of the Schmitt Trigger Circuit using Transistors.—K. Lebenwurst. (*NachrTech.*, Dec. 1960, Vol. 10, No. 12, pp. 519–524.) Equivalent circuits and characteristic curves are derived; results of measurements are given for comparison.

621.373.431.1 : 621.382.23 **3677**

The Tunnel-Diode Pair.—D. J. Hamilton & M. J. Morgan. (*Semiconductor*

Prod., July 1961, Vol. 6, No. 7, pp. 17–23.) The composite *V-I* characteristic of the twin circuit is considered and its application in the design of astable, monostable and bistable multivibrators is illustrated; trigger requirements and effects of loading can also be determined.

621.374 **3678**

A Low-Level Linear Rundown Circuit for Pulse Height to Pulse Width Conversion.—D. L. Endsley, W. W. Grannemann & T. Summers. (*Commun. & Electronics*, May 1961, No. 54, pp. 150–152.) A two-transistor device consisting of a constant-current generator and an emitter follower circuit is described. Experimental and theoretical analysis of the circuit are in good agreement.

621.374 : 621.382.23 **3679**

Tunnel-Diode Fast-Step Generator produces Positive or Negative Steps.—R. Carlson. (*Electronics*, 28th July 1961, Vol. 34, No. 30, pp. 48–49.) The generator produces pulses of about 2 μs duration having a rise time of 0·5 ns at recurrence frequencies up to 100 kc/s.

621.374 : 621.382.333 **3680**

The Collector-Coupled Complementary Pair.—V. Spáný. (*Electronic Engng*, Aug. 1961, Vol. 33, No. 402, pp. 526–527.) The astable mode gives phantastron-type waveforms with peak-to-peak voltages almost equalling the supply voltage. The bistable mode gives thyratron-type characteristics.

621.374.3 : 621.382.3 **3681**

Fast Coincidence Circuits using Avalanche Transistors.—J. C. Artiges & J. C. Brun. (*J. Phys. Radium*, Feb. 1961, Vol. 22, Supplement to No. 3, *Phys. appl.*, pp. 53A–58A.) The circuit described has a resolution time of 2 ns and an efficiency of 90%. Results of tests made with (*a*) a pulse generator, and (*b*) a pair of photomultipliers are reported.

621.374.32 : 621.382.3 **3682**

An Automatic Self-Checking Transistor Counter with Digital Display.—H. I. Meuser & W. H. P. Leslie. (*Electronic Engng*, Aug. 1961, Vol. 33, No. 402, pp. 604–609.)

621.374.32 : 681.142 **3683**

A Fast Binary Counter.—E. Taranto. (*J. Brit. Instn Radio Engrs*, July 1961, Vol. 22, No. 1, pp. 31–32.) "A transistor binary counter employing seven flip-flops is described. Its operation is dependent only on the switching time of one flip-flop which may be ≈ 100 ns."

621.374.4 : 621.372.44 **3684**

A Tripler Circuit using a Capacitance Diode.—D. Lehrmann & W. Marks. (*Frequenz*, Jan. 1961, Vol. 15, No. 1, pp. 9–12.) Mathematical analysis of a frequency tripler circuit and derivation of an equivalent circuit. The results of the analysis and of measurements on a practical circuit are compared.

621.374.5 **3685**

The Pulse Response of a Delay Line.—P. Poinsotte. (*Câbles & Transm.*, April 1961, Vol. 15, No. 2, pp. 93–98.) An expression is developed for each element of the network and a solution is obtained in the form of a convergent Neumann series.

621.375.018.756 : 621.382.23 **3686**

Zener Diode creates Logarithmic Pulse Amplifier.—D. Ophir & U. Galil. (*Electronics*, 14th July 1961, Vol. 34, No. 28, pp. 68–70.) Amplification over three decades is achieved by using as the logarithmic device a Zener diode to which a small resistance has been added to straighten the characteristic curve.

621.375.221 **3687**

Note on the Series Correction of Wide-Band Amplifiers.—A. V. J. Martin. (*Onde élect.*, March 1961, Vol. 41, No. 408, pp. 258–262.) A variation of the series-inductance correction circuit is considered in which the load resistance is connected across the output, and the circuit designed for either maximally flat transfer impedance or maximally flat input impedance. Inconvenient ratios of input to output capacitance can be avoided by using a cathode-follower stage.

621.375.3 **3688**

A New Magnetic-Controlled Rectifier Power Amplifier with a Saturable Reactor Controlling 'On' Time.—R. E. Morgan. (*Commun. & Electronics*, May 1961, No. 54, pp. 132–135.)

621.375.4 **3689**

Problems relating to Transistor Power Amplifiers.—G. B. Debiasi. (*Alta Frequenza*, Feb. 1961, Vol. 30, No. 2, pp. 114–121.) The design of transformerless a.f. output amplifiers is considered, and a graphical method for determining transistor thermal stability is given.

621.375.4.024 **3690**

A Circuit for the Compensation of Voltage Drift in the Input Stage of a Direct-Coupled Transistor D.C. Amplifier.—U. Holken. (*Nachrichtentech. Z.*, Jan. 1961, Vol. 14, No. 1, pp. 32–36.) In the circuit given the temperature drift of the base/emitter voltage has been compensated almost to the theoretical limit.

621.375.4.024 : 621.398 **3691**

Differential Amplifier with Regulator Achieves High Stability, Low Drift.—R. D. Middlebrook & A. D. Taylor. (*Electronics*, 28th July 1961, Vol. 34, No. 30, pp. 56–59.) A transistor d.c. amplifier suitable for missile telemetry systems is described.

621.375.426 **3692**

Narrow-Band Amplification with Transistors.—E. R. Hauri: H. Beneking. (*Nachrichtentech. Z.*, Jan. 1961, Vol. 14, No. 1, pp. 37–39.) Contribution to 4149 of 1960 with author's reply.

621.375.9 : 538.569.4 **3693**

Field-Swept Maser Oscillation.—J. C. Kemp. (*Phys. Rev. Lett.*, 1st July 1961, Vol. 7, No. 1, pp. 21–23.) The application by Singer & Wang (2097 of September) of their analysis of maser oscillations to experimental results of the author is criticized. They attribute the oscillations to energy exchange between cavity and emitting sample. The radiation envelope is, however, largely determined by the Zeeman field sweep rate, due to a different mechanism.

621.375.9 : 538.569.4 : 538.222 **3694**

Paramagnetic Maser Oscillator Analysis.—S. Wang & J. R. Singer. (*J. appl. Phys.*, July 1961, Vol. 32, No. 7, pp. 1371–1376.) An equation for the output waveform is derived and numerical solutions obtained using a computer. Good agreement with experiment is given for steady-state and field-swept oscillators.

621.375.9 : 538.569.4 : 621.396.43 **3695**

Project Echo: the Dual-Channel 2390-Mc/s Travelling-Wave Maser.—R. W. De Grasse, J. J. Kostelnick & H. E. D. Scovil. (*Bell Syst. tech. J.*, July 1961, Vol. 40, No. 4, pp. 1117–1127.) Details of the ruby material isolator and amplifier package construction are given. An instantaneous bandwidth of 13 Mc/s and effective noise temperature of 8°K were obtained and the gain (>33 dB) was sufficient to override the noise of the following stage.

621.375.9 : 621.372.44 **3696**

Parametric Amplifiers.—G. B. Stracca. (*Alta Frequenza*, Feb. 1961, Vol. 30, No. 2, pp. 98–113.) Theoretical comparison of gain, bandwidth, noise and stability of the negative-resistance amplifier and upper- or lower-sideband converters. Experimental results are also reported. For English version see *ibid.*, March 1961, Vol. 30, No. 3, pp. 244–256.

621.375.9 : 621.372.44 **3697**

The Wide Tuning Range of Backward Travelling-Wave Parametric Amplifiers.—H. Hsu & S. Wanuga. (*Proc. Inst. Radio Engrs*, Aug. 1961, Vol. 49, No. 8, pp. 1339–1340.) A method is indicated of increasing the range beyond that suggested by Straus (*Trans. Inst. Radio Engrs*, Jan. 1961, Vol. MTT-9, No. 1, p. 95.)

621.375.9 : 621.372.44 : 621.382.2 **3698**

Theory of Nonreciprocal Circuits with Equal Input and Output Frequency using Nonlinear Semiconductor Elements.—R. Maurer & K. H. Löcherer. (*Arch. elekt. Übertragung*, Feb. 1961, Vol. 15, No. 2, pp. 71–83.) The quadripole equations and transfer gain are derived for nonreciprocal amplifiers which consist of tunnel-diode or parametric-diode converter stages in cascade connection [see also 93 of January (Maurer et al.)]. Matching and decoupling problems are considered for various circuit configurations.

621.375.9 : 621.372.44 : 621.382.23 **3699**

Signal and Noise Characteristics of Diode-Reactance Amplifiers for the U.H.F. Region.—R. Maurer. (*Radio Mentor*, Feb. 1961, Vol. 27, No. 2, pp. 110–113.) Examples are given of mixer circuits, straight amplifiers, and a travelling-wave amplifier using parametric-amplifier techniques. The problem of matching by means of nonreciprocal elements or by bridge circuit is also dealt with.

621.375.9 : 621.372.44 : 621.391.822 **3700**

Noise Figure and Stability of Negative-Conductance Amplifiers.—A. C.

MacPherron. (*Proc. Inst. Radio Engrs*, Aug. 1961, Vol. 49, No. 8, pp. 1314–1315.) Calculations of lowest noise figure attainable from stability considerations are in agreement with results of an earlier analysis [2277 of 1960 (Van der Ziel & Tamiya)], but the lowest possible noise figure is obtained at the expense of stability.

621.375.9 : 621.372.44 : 621.396.969.3 **3701**

Project Echo: 961-Mc/s Lower-Sideband Up-Converter for Satellite-Tracking Radar.—M. Uenohara & H. Seidel. (*Bell Syst. tech. J.*, July 1961, Vol. 40, No. 4, pp. 1183–1205.) The amplifier is pumped at 11·7 Gc/s and although regenerative it has been made unconditionally stable by careful mechanical and electrical design. The overall noise figure is 1·6 dB, gain 22 dB and bandwidth 20 Mc/s.

621.375.9 : 621.382.23 **3702**

A Tunnel-Diode Slot Transmission Amplifier.—M. E. Pedinoff. (*Proc. Inst. Radio Engrs*, Aug. 1961, Vol. 49, No. 8, pp. 1315–1316.) A negative-conductance waveguide transmission-type amplifier consisting of a tunnel-diode mounted within an S-band waveguide end-plate slot has been built operating at a frequency of 2·7 Gc/s with a bandwidth of 21 Mc/s and 16 dB gain. No measurements have yet been made of noise figure.

621.376 : 621.372.54 **3703**

The Matching Problem of the Ring-Type and Double Push-Pull Modulator with Filter Termination at Both Ends.—H. Bauch. (*Arch. elekt. Übertragung*, Jan. 1961, Vol. 15, No. 1, pp. 1–17.) Detailed discussion of an impedance matching method for obtaining optimum frequency response and minimum attenuation.

621.376.22 **3704**

A Ring Modulator with Integrated Filters.—J. Salzmann. (*Câbles & Transm.*, April 1961, Vol. 15, No. 2, pp. 148–159.) A lossless four-terminal frequency-translating network is proposed which avoids using a transformer between rectifiers and filters.

GENERAL PHYSICS

535.215 **3705**

Theory of Photoexcitation in Solids.—A. Meesen. (*J. Phys. Radium*, March 1961, Vol. 22, No. 3, pp. 135–141.) The theory of optical absorption by photo-excitation is reviewed and further investigated. A distinction is made between 'oblique' and 'vertical' transitions.

537.311.1 **3706**

Tunnelling from an Independent-Particle Point of View.—W. A. Harrison. (*Phys. Rev.*, 1st July 1961, Vol. 123, No. 1, pp. 85–89.) Calculation of wave functions for tunnelling problems, with applications.

537.52 : 538.63 **3707**

Radio-Frequency Breakdown Controlled by Drift of Electrons in an Inhomogeneous Magnetic Field.—L. T. Shepherd & H. M. Skarsgard. (*Canad. J. Phys.*, July 1961, Vol. 39, No. 7, pp. 983–992.) Measurements of breakdown r.f. electron field versus magnetic field were made at pressures between 1·25 and 6 × 10⁻³ mm in H and He. The breakdown r.f. field varied as the inverse square root of the magnetic field as predicted by theory.

537.525 **3708**

Experimental Evidence for Beam-Plasma Interaction in a Low-Pressure Argon Discharge.—L. H. Putnam, H. D. Collins & N. L. Oleson. (*Phys. Rev. Lett.*, 1st Aug. 1961, Vol. 7, No. 3, pp. 77–79.)

537.533 **3709**

Broadening of a Beam of Electrons by the Space Charge.—M. Boivin. (*J. Phys. Radium*, Nov. 1960, Vol. 21, Supplement to No. 11, *Phys. appl.*, pp. 171A–172A.) A recurrence formula is developed for computing the broadening of the beam.

537.56 **3710**

Filamentary Structure Produced by an Electric Current in a Plasma.—H. Alfvén. (*Ark. Fys.*, Bd. June 1961, Vol. 19, No. 4, pp. 375–378.) An electric field parallel to a magnetic field in a plasma at low pressure produces a current which is confined to a filament. Simple formulae are given for the cross-section of the filament and the current in it.

537.56 **3711**

Space Dispersive Properties of Plasma.—J. Neufeld. (*Phys. Rev.*, 1st July 1961, Vol. 123, No. 1, pp. 1–10.)

537.56 : 537.533 **3712**

Interaction of Fast Electron Beams with Longitudinal Plasma Waves.—Ya. A. Romanov & G. F. Filippov. (*Zh. eksp. teor. Fiz.*, Jan. 1961, Vol. 40, No. 1, pp. 123–132.) Equations are derived for the variation with time of the plasma-wave spectral density and the fast-electron distribution function, for arbitrary velocity distributions.

537.56 : 538.56 **3713**

Waves in a Rarefied Ionized Gas Propagated Transverse to an External Magnetic Field.—T. Watanabe. (*Canad. J. Phys.*, July 1961, Vol. 39, No. 7, pp. 1044–1057.) Three modes of plane waves, in which the perturbed magnetic field is parallel to the external magnetic field, can be propagated transverse to the external magnetic field in a collision-free and fully ionized gas. In the h.f. limit the three modes behave respectively as e.m., electron sound, and ion sound waves.

537.56 : 538.566 : 535.43 **3714**

Concerning the Disturbances Produced by a Body Moving in a Plasma.—L. P. Pitaevskiĭ & V. Z. Kresin. (*Zh. eksp. teor. Fiz.*, Jan. 1961, Vol. 40, No. 1, pp. 271–281.) Formulae derived for the disturbance of electron density are used to calculate the effective cross-section for the scattering of e.m. waves at this disturbance in particular cases.

537.56 : 538.6 **3715**

Electrohydromagnetic Waves in a Fully Ionized Gas: Part 2.—K. D. Cole. (*Planet. Space Sci.*, Aug. 1961, Vol. 5, No. 4, pp. 292–296.) The Appleton-Hartree dispersion formula for magneto-ionics is generalized to include the effect of heavy ions. The ratio of particle energy to magnetic field energy in a wave of arbitrary frequency is determined. A band of frequencies around the plasma frequency is found for which waves are attenuated. Location of these bands would enable the interplanetary magnetic field and electron density to be estimated. Part 1 : 2305 of 1960.

537.56 : 538.63 **3716**

The Statistical Mechanics, Dynamics and Magnetohydrodynamics of Plasmas.—E. Jancel & T. Kahan. (*Cah. Phys.*, Feb. 1961, Vol. 15, No. 126, pp. 57–101.) A system of equations is established in particular to denote the movement, the current and the compression tensor of an ionized gas. These are applied to partially and completely ionized gases and used to obtain the general equations of magneto-hydrodynamics. Propagation modes of different types of wave are determined.

537.56 : 538.63 **3717**

On Plasma Oscillations with Special Emphasis on the Landau Damping and the Gross Gaps in the Frequency Spectrum.—A. Kildal. (*Nuovo Cim.*, 1st April 1961, Vol. 20, No. 1, pp. 104–122. In English.) A linear theory of oscillations of the form $\exp[i(\mathbf{k}.\mathbf{r}-\omega t)]$ in a collision-free electron plasma in an external magnetic field is given.

537.56 : 538.63 **3718**

Collective Motions in a Plasma due to Magnetic Interaction.—G. Kalman. (*Nuovo Cim.*, 1st April 1961, Vol. 20, No. 1, pp. 198–200.) The existence of collective modes due to the static magnetic interaction between the current elements represented by the moving electrons has been investigated.

537.56 : 538.63 **3719**

Plasma Density Fluctuations in a Magnetic Field.—E. E. Salpeter. (*Phys. Rev.*, 15th June 1961, Vol. 122, No. 6, pp. 1663–1674.) A continuation of earlier work (*ibid.*, 1st Dec. 1960, Vol. 120, No. 5, pp. 1528–1535) in which the frequency spectrum was derived for the spatial Fourier transform of the electron charge density fluctuations in a plasma. The effects of a constant magnetic field in an arbitrary direction are considered. A theoretical basis is provided for analysing back-scatter experiments, and intensities are derived as a function of the real frequency variable for the case of thermodynamic equilibrium.

538.311 : 621.318.3 **3720**

Hydromagnet: a Self-Generating Liquid-Conductor Electromagnet.—H. H. Kolm & O. K. Mawardi. (*J. appl. Phys.*, July 1961, Vol. 32, No. 7, pp. 1296–1304.) The exciting current is generated by forcing a liquid conductor radially inwards across an axial magnetic field. The tangential current thus generated adds to the initial applied field.

538.561 : 537.122 **3721**

Emergence into Vacuum of the Cherenkov Radiation produced by

Longitudinal Waves in a Medium.—B. L. Zhelnov. (*Zh. eksp. teor. Fiz.*, Jan. 1961, Vol. 40, No. 1, pp. 170–177.) The e.m. radiation of an electron moving into a vacuum from a medium with spatial dispersion is considered. Under certain conditions, in addition to the transition radiation there is Cherenkov radiation from longitudinal waves in the medium. At large distances from the interface this radiation is a spherical wave confined to a narrow range of frequencies near the plasma frequency.

538.561.029.65: 537.533 **3722**

Coherent Generation of Microwave Power by Annihilation Radiation of a Pre-bunched Beam.—R. W. Hübl & H. J. Kromme. (*Proc. Inst. Radio Engrs*, Aug. 1961, Vol. 49, No. 8, p. 1358.) Millimetre wave radiation at the 180 mW level has been produced by the creation and annihilation of a tightly bunched 0·8 MeV electron beam. A proposed extension of the method, based on optical techniques, is intended to produce power in the submillimetre region.

538.566: 535.42 **3723**

The Problem of Diffraction of Electromagnetic Waves at a Perfectly Conducting Plane Ring.—G. S. Gruzberg & E. N. Kolesnikova. (*Zh. tekh. Fiz.*, Jan. 1961, Vol. 31, No. 1, pp. 13–17.) Theoretical treatment of the diffraction of plane e.m. waves assuming a ring of internal radius and width much greater than the wavelength. Integral equations for the 'shadow' currents are given, from which the total current flowing in the screen is determined.

538.566: 535.42 **3724**

Diffraction of a Plane Wave by a Unidirectionally Conducting Half-Plane.—S. R. Seshadri. (*Proc. nat. Inst. Sci. India*, Part A, 26th Jan. 1961, Vol. 27, No. 1, pp. 1–10.) The problem is formulated in terms of an integral equation specifying the screen function, whose solution is obtained by the standard Wiener-Hopf procedure. Expressions for the fields and the current induced on the half-plane are given.

538.566: 535.42 **3725**

A Note on the Diffraction of a Scalar Wave by a Small Circular Aperture.—R. A. Hurd. (*Canad. J. Phys.*, July 1961, Vol. 39, No. 7, pp. 1065–1070.)

538.566: 537.56 **3726**

Kinetic Theory of Reflection of Electromagnetic Waves from a Moving Plasma.—V. I. Kurilko. (*Zh. tekh. Fiz.*, Jan. 1961, Vol. 31, No. 1, pp. 71–77.) Mathematical analysis of the reflection of e.m. waves from a plasma moving in a space in which the phase velocity of the waves is less than the velocity of light.

538.566.029.6: 535.43: 537.56 **3727**

Scattering of Microwaves from a Cylindrical Plasma in the Born Approximation: Part I.—Y. Midzuno. (*J. phys. Soc. Japan*, May 1961, Vol. 16, No. 5, pp. 971–980.) Formulae are derived for the angular distribution function and the effect of special distributions is considered.

538.569.4 **3728**

Some Properties of Resonance Line-Shape Functions.—D. G. Hughes & D. K. C. MacDonald. (*Proc. phys. Soc.*, 1st July 1961, Vol. 78, No. 499, pp. 75–80.) Mathematical discussion of the broadening of spectral lines.

538.569.4: 537.228.1 **3729**

Shift of Nuclear Quadrupole Resonance Frequency by Electric Field.—T. Kushida & K. Suzki. (*Phys. Rev. Lett.*, 1st July 1961, Vol. 7, No. 1, pp. 9–10.) A linear shift in the Br^{81} line in $NaBrO_3$ is observed when a field of several kV/cm is applied parallel to the [111] crystal axis. The line shape becomes asymmetric, and is attributed to unresolved line splitting.

538.569.4: 537.228.1 **3730**

Linear Effect of Applied Electric Field on Nuclear Quadrupole Resonance.—J. Armstrong, N. Bloembergen & D. Gill. (*Phys. Rev. Lett.*, 1st July 1961, Vol. 7, No. 1, pp. 11–14.) A linear Stark effect is observed in the Cl^{35} line in $KClO_3$ and $NaClO_3$ crystalline powders, as predicted theoretically.

538.569.4: 537.29 **3731**

Linear Effect of Applied Electric Field on Magnetic Hyperfine Interaction.—N. Bloembergen. (*Phys. Rev. Lett.*, 1st Aug. 1961, Vol. 7, No. 3, pp. 90–92.)

538.569.4: 621.375.9 **3732**

Angular Variation of Axial Spin-Hamiltonian Eigenvalues in Strong Magnetic Field.—H. A. Buckmaster. (*Canad. J. Phys.*, July 1961, Vol. 39, No. 7, pp. 1073–1079.) The expressions for the energies of transitions between levels with strong field quantum numbers M and $M - m$ are given for $m = 1, 2, 3$. The tables give the values of the coefficients containing S and M for a range of values of these parameters.

538.569.4: 621.375.9: 535.61-1/2 **3733**

A Proposal for a Tunable Source of Radiation for the Far Infrared using Beats between Optical Masers.—D. C. Lainé. (*Nature, Lond.*, 19th Aug. 1961, Vol. 191, No. 4790, pp. 795–796.)

538.569.4: 621.375.9: 535.61-2 **3734**

Theory of Quantum Oscillators in a Multimode Cavity.—W. G. Wagner & G. Birnbaum. (*J. appl. Phys.*, July 1961, Vol. 32, No. 7, pp. 1185–1194.) The distribution of power in the various modes in the steady-state operation of an optical maser is studied.

538.569.4: 621.375.9: 535.61-2 **3735**

Proposed Technique for Modulation of Coherent Light.—A. K. Kamal & S. D. Sims. (*Proc. Inst. Radio Engrs*, Aug. 1961, Vol. 49, No. 8, p. 1331.) A frequency shift of the coherent-light output proportional to the strength of an electric field applied to a ruby laser provides a system for f.m. of the output.

GEOPHYSICAL AND EXTRATERRESTRIAL PHENOMENA

523.164 **3736**

Studies in Cosmic Radio Noise at Bangalore.—S. Bhagavantam, M. Krishnamurthi & S. Ramakrishna. (*J. Indian Inst. Sci.*, April 1961, Vol. 43, No. 2, pp. 97–103.) The techniques in use at Bangalore for a radio survey of the sky and the disturbed sun at 29·6 Mc/s and 62 Mc/s are described.

523.164.3: 551.507.362.2 **3737**

Investigations of Cosmic Noise Measurements at 3·6 Mc/s from Satellite 1960 ι.—J. H. Chapman & A. H. Vickroy. (*Nature, Lond.*, 29th July 1961, Vol. 191, No. 4787, p. 680.) The analysis given is based on the assumption that observed variations in signal strength were due to three causes: (*a*) variation of radiation resistance of the aerial with the dielectric constant of the surrounding ionosphere, (*b*) restriction of the angular aperture of the aerial due to ionospheric refraction and polarization, and (*c*) variation of cosmic-noise power over the sky.

523.164.32: 551.510.535 **3738**

Oscillations in the Refraction of Radio Waves Emitted by the Sun.—B. M. Chikhachev. (*Radiotekhnika i Elektronika*, Sept. 1960, Vol. 5, No. 9, pp. 1359–1363.) Radio astronomy observations at sunrise in November and December 1959 at wavelengths of 1·5 and 2 m showed a periodic variation of ionospheric refraction with uniform change of zenith distance of the sun. This variation is analysed in terms of sunspot activity and the motion of 'cellular' waves in the ionosphere [see 1680 of 1950 (Martyn)].

523.164.34 **3739**

Lunar Temperature Measurements at 3 200 Mc/s.—W. J. Medd & N. W. Broten. (*Planet. Space Sci.*, Aug. 1961, Vol. 5, No. 4, pp. 307–313.)

523.164.4 **3740**

Distribution of Brightness in Extragalactic Radio Sources.—A. T. Moffet & P. Maltby. (*Nature, Lond.*, 29th July 1961, Vol. 191, No. 4787, pp. 453–454.) Measurements have been made at 31·3 cm λ both on N-S and E-W base lines with a resolution of about 1·5′. Interpretations are given of the asymmetry observed in 88 sources.

523.164.4 **3741**

The Radio Source Hercules A.—P. J. S. Williams, D. W. Dewhirst & P. R. R. Leslie. (*Observatory*, April 1961, Vol. 81, No. 921, pp. 64–68, plate.) Interferometer observations were made at 178 Mc/s on the two components of the intense source. The separation in declination is $0'{\cdot}32 \pm 0'{\cdot}60$.

523.164.4 **3742**

Central Component of the Radio Source Centaurus *A*.—P. Maltby. (*Nature, Lond.*, 19th Aug. 1961, Vol. 191, No. 4790, pp. 793–794.) Observations made with a variable-spacing interferometer at 21·6 and 31·3 cm show that the radiation originates outside the wide dust band.

523.165 **3743**

Flux and Energy Spectra of the Protons in the Inner Van Allen Belt.—J. E. Naugle & D. A. Kniffen. (*Phys. Rev. Lett.*, 1st July 1961, Vol. 7, No. 1, pp. 3–6.)

523.165 **3744**

Energy Spectrum of Electrons Trapped in the Geomagnetic Field.—M.

Walt & W. M. MacDonald. (*J. geophys. Res.*, July 1961, Vol. 66, No. 7, pp. 2047–2052.) Solutions of the Fokker-Planck equation for the electron distribution function are obtained by reducing the equation to an eigenvalue problem. The spectrum obtained with a source of decaying albedo neutrons is at variance with the observed result.

523.165: 551.507.362.2 **3745**

Characteristics of the Van Allen Radiation Zones as Measured by the Scintillation Counter on Explorer VI.—A. Rosen & T. A. Farley. (*J. geophys. Res.*, July 1961, Vol. 66, No. 7, pp. 2013–2028.) Results were obtained over a period of four weeks from a counter recording fluxes of electrons above 200 keV and protons above 2 MeV. A geomagnetic storm which occurred about a week after launching the satellite produced an immediate increase in the counting rate; large fluctuations in particle intensity were observed at the edge of the outer Van Allen belt during the storm, which were closely related to simultaneous geomagnetic activity.

523.5 **3746**

On Meteor Ablation in the Atmosphere.—F. Verniani. (*Nuovo Cim.*, 1st Feb. 1961, Vol. 19, No. 3, pp. 415–442.) Improvements to the usually adopted theory are given and approximate expressions suggested for the fundamental equation of ablation of low-velocity meteors.

523.5: 621.396.96 **3747**

Reduction of Meteor Velocities from Continuous-Wave Radio Records.—D. W. R. McKinley & E. L. R. Webb. (*Mon. Not. R. astr. Soc.*, 1961, Vol. 122, No. 3, pp. 255–262.) An analysis of the reduction technique used at Ottawa shows that in velocity measurements any statistical bias was positive and less than 1%.

550.385.37 **3748**

Some Studies of Geomagnetic Micropulsations.—R. A. Duncan. (*J. geophys. Res.*, July 1961, Vol. 66, No. 7, pp. 2087–2094.) Recordings made at four stations in Australia are analysed. The period of the continuous type of oscillation (Pc) increases with latitude, and also varies diurnally. The damped trains of oscillations (Pi), occurring mainly near midnight, are followed by magnetic bays with an average delay of about 15 min. Effects observed during magnetic storms are discussed.

550.385.4 **3749**

Some Features of Magnetic Storms in High Latitudes.—D. G. Knapp. (*J. geophys. Res.*, July 1961, Vol. 66, No. 7, pp. 2055–2085.) Ionospheric currents in high latitudes during magnetic disturbances are deduced from magnetic data. Lists of disturbances, during and prior to the I.G.Y., are given.

551.507.362: 523.3/.4 **3750**

The National Program for Lunar and Planetary Exploration.—A. R. Hibbs. (*J. geophys. Res.*, July 1961, Vol. 66, No. 7, pp. 2003–2012.) An illustrated description of the 'Ranger' and other planned spacecraft.

551.507.362: 537.56 **3751**

Excitation of Plasma Waves by Radios Moving in Ionized Atmosphere.—K. P. Chopra. (*Planet. Space Sci.*, Aug. 1961, Vol. 5, No. 4, pp. 288–291.) An ionized cloud, formed in front of a rapidly moving body, excites waves by interaction with the ambient plasma. Extraordinary e.m. waves are generated in the presence of a suitable weak magnetic field.

551.507.362.1: 550.380.8 **3752**

On the Interplanetary Magnetic Storm: Pioneer V.—P. J. Coleman, Jr, C. P. Sonett & L. Davis, Jr. (*J. geophys. Res.*, July 1961, Vol. 66, No. 7, pp. 2043–2046.) A magnetic field of 20 to 50 γ was detected by Pioneer V perpendicular to the sun-earth line during periods of intense solar activity between 26th March and 6th April 1960. Quiet-time fields of 2·7 γ were observed on other occasions.

551.507.362.1: 550.385.4: 523.14 **3753**

Magnetic Storms in Interplanetary Space as Observed by Pioneer V.—E. W. Greenstadt. (*Nature, Lond.*, 22nd July 1961, Vol. 191, No. 4786, pp. 329–331.) A positive correlation is found between the interplanetary field measured at the satellite and the planetary magnetic index a_p during the flight of Pioneer V from launch on 11th March 1960 to the end of April. Magnetic storms at the satellite occur at the same time as earth storms although there is a slight delay towards the end of the period of telemetry.

551.507.362.2 **3754**

Satellite Flashing-Light System.—R. Freed & L. S. Klivans. (*Electronic Ind.*, April 1961, Vol. 20, No. 4, pp. 94–98.) To provide increased accuracy of the determination of the position of a satellite, a coded flashing-light system could be carried. Design details are given.

551.507.362.2 **3755**

Effect of an Oblate Rotating Atmosphere on the Orientation of a Satellite Orbit.—G. E. Cook. (*Proc. roy. Soc. A*, 25th April 1961, Vol. 261, No. 1305, pp. 246–258.) For inclinations of 60°, 70° in particular, significant rotation of the major axis in the orbital plane occurs due to the atmosphere.

551.507.362.2 **3756**

Atmospheric Phenomena noted in Simultaneous Observations of 1958 δ2 (Sputnik III).—J. Aarons, H. E. Whitney, R. S. Roger, J. Thomson, J. Bournazel, E. Vassy, H. A. Hess, K. Rawer, N. Carrara, P. Checcacci, B. Landmark, J. Tröim, B. Hultqvist & L. Liszka. (*Planet. Space Sci.*, July 1961, Vol. 5, No. 3, pp. 169–184.) Events occurring in three typical revolutions of Sputnik III are described; measurements were made on the 20 Mc/s transmissions. Signal drop-outs due to transmitter failure were noted and another type of signal decrease was attributed to localized absorbing regions. Regions of the ionosphere causing scintillation were also identified; they have an extent in the horizontal plane of several hundred km.

551.507.362.2 **3757**

Methods of Calculating Atmospheric Densities from Satellite Orbit Data.—G. V. Groves. (*Planet. Space Sci.*, Aug. 1961, Vol. 5, No. 4, pp. 314–320. In French.) Formulae relating atmospheric density to the rate of change of period of a satellite as obtained by various workers are reviewed, and are shown to be in sufficient agreement to meet practical needs.

551.507.362.2: 523.164: 621.391.812 **3758**

Ray Paths from a Cosmic Radio Source to a Satellite in Orbit.—C. B. Haselgrove, J. Haselgrove & R. C. Jennison. (*Proc. roy. Soc. A*, 16th May 1961, Vol. 261, No. 1306, pp. 423–434.) A satellite above the F_2 maximum can receive radiation on frequencies that are totally reflected by the ionosphere. Two effects of reflection in the upper part of the ionosphere are discussed: (*a*) focusing, and (*b*) interference. Both occur particularly when a satellite enters or leaves a region in which it can receive radiation from a point source in space.

551.507.362.2 : 523.72 **3759**

Measurement of Solar X-Radiation.—K. A. Pounds. (*J. Brit. Instn Radio Engrs*, Aug. 1961, Vol. 22, No. 2, pp. 171–175.) The X-ray emission measuring equipment to be carried in Skylark rockets and the satellite U.K. 1 is described. Both X-ray flux and spectral shape are to be investigated.

551.507.362.2: 551.510.535 **3760**

Local Electron Densities deduced from the Faraday Fading of Satellite Transmissions using Measurements during Two Consecutive Transits.—L. Liszka. (*Planet. Space Sci.*, July 1961, Vol. 5, No. 3, pp. 213–219.) In the analysis it is assumed that during the period of revolution of the satellite the relative gradients of the local electron density are constant at the same altitudes and the changes in density above the F_2 maximum are the same as those within the F_2 layer. Daytime observations of 1958 δ2 in September 1959 have been analysed.

551.507.362.2: 621.391.812.63 **3761**

Scintillations and the Latitude Distribution of Ionospheric Irregularities.—D. G. Singleton. (*Nature, Lond.*, 29th July 1961, Vol. 191, No. 4787, pp. 482–483.) Evidence is given in support of Kent's interpretation of the rapid fading of earth-satellite signals (488 of 1960). Mawdsley's alternative explanation of scattering by field-aligned irregularities (4215 of 1960) is not confirmed by experiment.

551.507.362.2: 621.396.9 **3762**

Radio Tracking of Artificial Earth Satellites.—Pressey. (See 3704.)

551.507.362.2: 621.396.963.3 **3763**

Tracking and Display of Earth Satellites.—Van Gelder, Jr. (See 3708.)

551.510.53 **3764**

Charged Particles in the Upper Atmosphere.—A. Dalgarno. (*Ann. Géophys.*, Jan.–March 1961, Vol. 17, No. 1, pp. 16–49. In English.) A comprehensive review of collision processes involving charged particles in the upper atmosphere. 225 references.

551.510.53 **3765**

Structure, Variations and Movements of the Earth's Ionosphere and

Exosphere.—C. Altman. (*Bull. Res. Counc. Israel*, Feb. 1961, Vol. 9C, Nos. 1/2, pp. 39–48.) A survey of present knowledge and work being conducted at the Technion, Israel Institute of Technology, Haifa.

551.510.53 **3766**

The Distribution of Minor Ions in Electrostatic Equilibrium in the High Atmosphere.—P. Mange. (*J. geophys. Res.*, Nov. 1960, Vol. 65, No. 11, pp. 3833–3834.) A simple discussion of the factors which govern the distribution of ions in diffusive equilibrium. The scale height of the predominant ion is twice that of the corresponding neutral constituent, and the concentration of a minor light ion can increase with altitude.

551.510.53 **3767**

Comments on Tidal Winds in the High Atmosphere.—B. Haurwitz. (*Planet. Space Sci.*, July 1961, Vol. 5, No. 3, pp. 196–201.) The accuracy of published data on tidal wind variations are discussed on the basis of computations of the indices of the probable-error circle: variations with seasons and elevation are real although their magnitudes may be unreliable.

551.510.535 **3768**

Diffusion in the Ionosphere: a Review of some Recent Work.—V. C. A. Ferraro. (*Ann. Géophys.*, Jan.–March 1961, Vol. 17, No. 1, pp. 82–89. In English.) Work by Gliddon & Kendall (2738 of 1960) shows considerable support for the hypothesis that F_1 and F_2 regions are produced by the same source of ionization.

551.510.535 **3769**

The Lunar Variation of the Virtual Height of the Normal Ionospheric E Layer above Fribourg.—P. Rougerie. (*Ann. Géophys.*, Jan.–March 1961, Vol. 17, No. 1, pp. 145–146. In English.) A semi-diurnal lunar variation of 0·1 km has been detected with a maximum at 0830 lunar time.

551.510.535 **3770**

Theory of Overhead Nonblanketing Sporadic E.—J. Renau. (*J. geophys. Res.*, July 1961, Vol. 66, No. 7, pp. 2121–2128.) Sequences of $h'(f)$ curves are calculated for an E layer in which a horizontal stratum of irregularities 1–2 km thick is slowly descending. The results are very similar to recorded sequences of ionograms showing sporadic E.

551.510.535 **3771**

Observations on the Ionospheric F Layer at Night: Part 1—The Law of Electron Loss in the F Layer.—C. S. G. K. Setty. (*J. Instn Telecomm. Engrs, India*, March 1961, Vol. 7, No. 2, pp. 65–77.) At night, electrons in the F layer are lost by attachment-like processes. The loss coefficients are of the form $\beta_z = \beta_{z_0} \exp[(h_0 - h)/H_0]$ where h_0 is the height at which $\beta_z = \beta_{z_0}$ and H_0 is the scale height of the loss coefficient. Assuming the loss coefficients are attributable to ion rates in chemical processes, H_0 values correspond to those of molecular oxygen and nitrogen. Part 2: 3995 of October.

551.510.535 **3772**

Sporadic-E Spread-F in Relation to Para-Auroral Height Changes and Magnetic Activity.—M. S. V. G. Rao & B. R. Rao. (*J. geophys. Res.*, July 1961, Vol. 66, No. 7, pp. 2113–2120.) The seasonal dependence of the correlations is found, and the data are considered in relation to Martyn's theory of the formation of spread F (see 1555 of 1959).

551.510.535: 550.385.4 **3773**

On the Relation between Magnetic Storm and Ionospheric Disturbances that Occurred on Sept. 13th 1957.—Y. Hakura, M. Nagai & Y. Sano. (*J. Radio Res. Labs, Japan*, March 1961, Vol. 8, No. 36, pp. 81–95.) The patterns of dense E_s, blackouts and F_2-layer disturbance in the northern hemisphere are compared with the current systems of geomagnetic disturbance at different stages of the storm. With the development of polar-cap blackout, several hours before the sudden commencement of the storm, a current system was produced in the polar cap region. During the main phase, blackouts and E_s coincide with strong currents at auroral latitudes.

551.510.535: 551.507.362.1 **3774**

Upper Atmospheric Turbulence near the 100 km Level.—J. E. Blamont & C. de Jager. (*Ann. Géophys.*, Jan.–March 1961, Vol. 17, No. 1, pp. 134–144. In English.) An examination of observations of a sodium trail produced by a Véronique rocket in the upper atmosphere.

551.510.536 **3775**

Hydrogen Atoms and Ions in the Thermosphere and Exosphere.—D. R. Bates & T. N. L. Patterson. (*Planet. Space Sci.*, Aug. 1961, Vol. 5, No. 4, pp. 257–273.) The structure of the atmosphere between 100 km and 500 km is discussed in terms of various models. For a further note on the temperature in the exosphere see *ibid.*, p. 329.

551.510.536: 551.507.362.2 **3776**

Variable Conditions of the Terrestrial Exosphere.—H. K. Paetzold & H. Zschörner. (*Astronautica Acta*, 1960, Vol. 6, No. 6, pp. 373–381.) The well-known features of atmospheric density variations as deduced from satellite observations are discussed. Data for at least ten satellites show evidence of an annual variation in atmospheric density with a minimum in July, the amplitude of the variation increasing with altitude.

551.510.536: 551.594.6 **3777**

Exospheric Electron Density Variations deduced from Whistlers.—E. A. Helliwell. (*Ann. Géophys.*, Jan.–March 1961, Vol. 17, No. 1, pp. 76–81. In English.) New data on electron density are presented. Density is approximately proportional to the strength of the earth's magnetic field. An unweighted annual variation, in which the December value is nearly twice that in June, is reported.

551.593 **3778**

Attitudes of the Night Airglow Radiations.—D. M. Packer. (*Ann. Géophys.*, Jan.–March 1961, Vol. 17, No. 1, pp. 67–75. In English.) Observational methods for obtaining the layer heights of airglow emission are briefly reviewed and results derived from ground measurements, rocket flights and kinetic temperatures are discussed.

551.593: 551.507.362.1 **3779**

Attempt to Measure Night Helium Glow—Evidence for Metastable Molecules in the Night Ionosphere.—E. T. Byram, T. A. Chubb & H. Friedman. (*J. geophys. Res.*, July 1961, Vol. 66, No. 7, pp. 2095–2100.) A rocket experiment, intended to measure the intensity of night-time He glow (wavelengths 584 Å and 304 Å) gave negative results, but provided some evidence for the existence of metastable molecules above 100 km.

551.594.5 **3780**

Some Auroral Observations inside the Southern Auroral Zone.—J. V. Denholm. (*J. geophys. Res.*, July 1961, Vol. 66, No. 7, pp. 2105–2111.)

551.594.6 **3781**

Guiding of Whistlers by the Magnetic Field.—R. Gendrin. (*Planet. Space Sci.*, Aug. 1961, Vol. 5, No. 4, pp. 274–282. In French.) A mechanism is proposed which explains the wideband noise observed during whistler reception. A particle moving with velocity $cf_H/2f_0$, where f_H is gyro-frequency and f_0 is plasma frequency, causes a wave to be propagated along the earth's magnetic field; all frequency components of the wave travel with the same velocity. See 201 of January (Smith).

551.594.6 **3782**

The Dispersion of Whistlers Compared with the Geomagnetic Latitudes of their Sources.—H. Norinder & E. Knudsen. (*Planet. Space Sci.*, Aug. 1961, Vol. 5, No. 4, pp. 326–328. In French.) Observational results are presented which indicate that the geomagnetic latitude of lightning discharges is a factor determining the dispersion constant of the related whistlers.

LOCATION AND AIDS TO NAVIGATION

621.396.9 **3783**

Development Trends of Modern Location Techniques: Correlation Location Methods.—F. H. Lange. (*Nachr.-Tech.*, Jan. 1961, Vol. 11, No. 1, pp. 2–7.) The application of the principles of 'correlation electronics' (3630 of 1958) to radiolocation systems is discussed.

621.396.9: 551.507.362.2 **3784**

Radio Tracking of Artificial Earth Satellites.—R. G. Prinsep. (*J. Brit. Instn Radio Engrs*, Aug. 1961, Vol. 22, No. 2, pp. 97–107.) The three principal methods using (a) radar, (b) Doppler frequency shift, and (c) interferometer are outlined. The construction, operation and performance of the interferometer system used in the U.S. Minitrack network are described.

621.396.933.2 **3785**

Controlled (V.F.) Flight Path System for Use during Climb and Descent.—R. D. Ryan. (*J. Inst. Nav.*, April 1961, Vol. 14, No. 2, pp. 195–201.) Any of a

number of accurate straight or curved flight paths may be selected in an attachment for the Australian d.m.e. system.

621.396.933.2 **3786**

Phase Difference Observations at Spaced Aerials and their Application to Direction Finding.—W. C. Bain. (*J. Res. nat. Bur. Stand.*, May/June 1961, Vol. 65D, No. 3, pp. 229–232.) Measurements on frequencies near 6 Mc/s are shown to give results indicating that the performance of a wide-aperture direction finder should not fall seriously below theoretical expectation.

621.396.933.2 **3787**

Research at the National Bureau of Standards applicable to Long-Distance Location and Direction-Finding Problems.—R. Silberstein. (*J. Res. nat. Bur. Stand.*, May/June 1961, Vol. 65D, No. 3, pp. 233–235.) A general account of work undertaken since 1941 including references to the development of a technique for determining polarization error, the development of Loran-C, a rapid-scan directional aerial, and the study of non-great-circle bearings.

621.396.933.2 **3788**

Instrumentation for Propagation and Direction Finding Measurements.—R. C. Hayden. (*J. Res. nat. Bur. Stand.*, May/June 1961, Vol. 65D, No. 3, p. 253.) Summary of a conference paper in which the limitations imposed on radio d.f. systems are discussed and two specific systems for use with wide-aperture arrays are proposed.

621.396.933.2 **3789**

***Brooke* Variance Classification System for D.F. Bearings.**—E. M. L. Beale. (*J. Res. nat. Bur. Stand.*, May/June 1961, Vol. 65D, No. 3, pp. 255–261.)

621.396.933.2 **3790**

Estimation of Variances of Position Lines from Fixes with Unknown Target Positions.—E. M. L. Beale. (*J. Res. nat. Bur. Stand.*, May/June 1961, Vol. 65D, No. 3, pp. 263–273.) See also 3789 above.

621.396.933.2 : 621.391.812.63 **3791**

Influence of Ionospheric Conditions on the Accuracy of High-Frequency Direction Finding.—P. J. D. Gething. (*J. Res. nat. Bur. Stand.*, May/June 1961, Vol. 65D, No. 3, pp. 225–228.) During ionospheric storms bearing accuracy is reduced when fixes result from signals propagated via the F_2 layer.

621.396.933.2 : 621.396.665 **3792**

Design for Spinning-Goniometer Automatic Direction Finding.—W. J. Lindsay & D. S. Heim. (*J. Res. nat. Bur. Stand.*, May/June 1961, Vol. 65D, No. 3, pp. 237–243.) The construction of an automatic sensing unit and of a bearing read-out computer is considered. The advantages of narrow-band synchronous post-detection filtering are discussed.

621.396.96 **3793**

Secondary Surveillance Radar.—D. H. R. Archer. (*Electronic Engng*, July & Aug. 1961, Vol. 33, Nos. 401 & 402, pp. 414–420 & 490–494.) System design problems are discussed, in particular methods of suppressing side-lobe effects. The application of a secondary-radar system for data transmission is considered.

621.396.962.3 **3794**

Superregenerative Pulse Radar.—F. H. Shepard, Jr. (*Proc. Radio Cl. Amer.*, Winter 1960/1961, Vol. 37, No. 1, pp. 1–5.) For pulse reception, where broad bandwidths are used, the signal/noise ratio is equal to that of other receiving systems. The basic circuit of a superregenerative radar transmitter-receiver is shown and a double-pulse technique for an A-scope display is outlined.

621.396.962.3 **3795**

A Monopulse Interconnection System.—F. P. Storke, Jr. (*Proc. Inst. Radio Engrs*, Aug. 1961, Vol. 49, No. 8, pp. 1328–1329.) The tracking error relative to the beam width is expressed in terms of the differential phase shifts before and after the comparing hybrid. The importance of the latter is shown and a system is described which is insensitive to phase shifts in the i.f. amplifier since reference and error signals undergo the servo phase shift in it. See 1240 of 1960 (Rhodes).

621.396.962.33 **3796**

Detection Range Predictions for Pulse Doppler Radar.—S. A. Meltzer & S. Thaler. (*Proc. Inst. Radio Engrs*, Aug. 1961, Vol. 49, No. 8, pp. 1299–1307.) A mathematical model is constructed. It is applicable to situations where thermal noise and side-lobe clutter limit detection range, and allows for variation of most of the important radar parameters.

621.396.963.3 **3797**

C.R.T. Display of Alphanumeric Information Applied to Radar Data Handling.—J. S. Johnston. (*J. Brit. Instn Radio Engrs*, Aug. 1961, Vol. 22, No. 2, pp. 139–143.) The problem of extracting and displaying in alphanumeric form the information presented by long-range radar is discussed. A writing speed of 3×10^6 characters/sec is possible.

621.396.963.3 : 551.507.362.2 **3798**

Tracking and Display of Earth Satellites.—A. Van Gelder, Jr. (*Proc. Inst. Radio Engrs*, Aug. 1961, Vol. 49, No. 8, pp. 1332–1333.) Comment on 2393 of 1960 (Slack & Sandberg). Several errors are corrected and certain steps in the derivation are questioned.

621.396.969.3 : 551.507.362.2 **3799**

***Project Echo*: Satellite-Tracking Radar.**—O. E. De Lange. (*Bell Syst. tech. J.*, July 1961, Vol. 40, No. 4, pp. 1157–1182.) A 960-Mc/s system with 60-ft and 10-ft paraboloids as transmitting and receiving aerials respectively is described. The transmitting system is shared with the 'Echo' communications channel, 2·5 kW being then available for radar. The 10-ft paraboloid is conically scanned and feeds a receiver incorporating a parametric amplifier with a sensitivity of −150 dBm in a 100-c/s bandwidth. Radar and optical pointing were found usually to agree to within a few tenths of a degree, but computed orbital azimuth data were in error by up to 1·2 degrees.

MATERIALS AND SUBSIDIARY TECHNIQUES

535.215 **3800**

Temperature-Dependent Biomath-Cesium Photosurfaces.—R. J. Zollweg & C. R. Taylor. (*J. appl. Phys.*, July 1961, Vol. 32, No. 7, pp. 1316–1319.) The sensitivity variation with temperature depends on the presence of oxygen and upon the size of the aggregates in the photosurface.

535.215 : 546.48'221 **3801**

Photoconductivity and Speed of Response in Cadmium Sulphide.—D. Shaw. (*Brit. J. appl. Phys.*, July 1961, Vol. 12, No. 7, pp. 337–341.) Photoconductivity and photocurrent decay times have been measured for a large number of crystals of widely varying photosensitivity over an illumination range 0·007–675 ft candles.

535.215 : 546.48'221 **3802**

p-Type Photoconductivity and Infrared Quenching in Electron-Bombarded CdS.—R. A. Kulp & R. H. Kelley. (*J. appl. Phys.*, July 1961, Vol. 32, No. 7, pp. 1290–1292.)

535.215 : 546.48'221 **3803**

Analysis of Photojunctions Formed by Diffusing Copper into Annealing Cadmium Sulphide Crystals.—R. E. Bischmeidt, J. E. Kampjola & D. S. Eddy. (*J. appl. Phys.*, July 1961, Vol. 32, No. 7, pp. 1324–1330.)

535.37 **3804**

Lead- and Manganese-Activated Calcium Cadmium Silicate Phosphors.—V. Urbanz, V. Kolnikr, I. Mamula & V. Kuchida. (*J. electrochem. Soc.*, March 1961, Vol. 108, No. 3, pp. 235–236.)

537.226 : 546.681'18 **3805**

Antiferromagnetism at p-n Junctions in Gallium Phosphide.—M. Gershenzon & R. M. Mikulyak. (*J. appl. Phys.*, July 1961, Vol. 32, No. 7, pp. 1338–1346.)

537.226 : 538.566.2.029.6 **3806**

Dispersion of the Permeability and Permittivity of Artificial Dielectrics in the Frequency Range 300–35 000 Mc/s.—I. A. Deryugin & M. A. Sigal. (*Zh. tekh. Fiz.*, Jan. 1961, Vol. 31, No. 1, pp. 100–108.) A report of measurements of the frequency dependence of the properties of Cu powders in paraffin.

537.226 : 546.814.31 **3807**

Dielectric Properties of SnO_2.—L. V. Deshpande & V. G. Bhide. (*Nature, Lond.*, 16th Feb. 1961, Vol. 19, No. 4, pp. 616–617.) Samples of SnO_2 in ceramic and compressed powder form have a dielectric constant of the order of 10^5 and show ferroelectric properties.

537.227 : 546.42'824-31 **3808**

Nonlinearity and Microwave Losses in Cubic Strontium-Titanate.—G. Rupprecht, R. O. Bell & R. D. Silverman. (*Phys. Rev.*, 1st July 1961, Vol. 123, No. 1, pp. 97–98.) A summary and interpretation

of results of measurements made on single crystals, at temperatures from 90° K to 230° K and frequencies from 1 to 50 c/s.

537.227: 546.431'824-31 1809

Preference of Macrodomains of $BaTiO_3$ Crystals.—K. Aizu & O. Nakada. (*J. phys. Soc. Japan*, May 1961, Vol. 16, No. 5, pp. 923–927.) A statistical investigation based on thermodynamics shows that a plate thicker than 2×10^{-4} cm contains practically an oversteply polarized microdomains.

537.227: 546.431'824-31 1810

Surface Layers on Barium Titanate Single Crystals above the Curie Point.—H. Schlosser & M. E. Drougard. (*J. appl. Phys.*, July 1961, Vol. 32, No. 7, pp. 1227–1231.) Dielectric dispersion measurements have been carried out on $BaTiO_3$ single crystals of different thickness at temperatures above the Curie point up to 180°C.

537.227: 546.431'824-31 1811

Investigation of Rare-Earth-Doped Barium Titanate.—V. J. Tennery & R. L. Cook. (*J. Amer. ceram. Soc.*, 1st April 1961, Vol. 44, No. 4, pp. 187–193.) The effect of additions of rare-earth oxides on the d.c. resistivity of $BaTiO_3$ is investigated.

537.227: 546.431'824-31 1812

Effect of WO_3 on Dielectric Properties of $BaTiO_3$ Ceramics.—V. Ern & R. E. Newnham. (*J. Amer. ceram. Soc.*, 1st April 1961, Vol. 44, No. 4, p. 198.)

537.227: 546.431'824-31 1813

Dielectric Properties of $BaTiO_3$ Single Crystals in the Paraelectric State from 1 kc/s to 2 000 Mc/s.—E. Sawaguchi & A. Lurio. (*Phys. Rev.*, 1st July 1961, Vol. 123, No. 1, pp. 117–123.)

537.227: 621.372.44 1814

Antiferroelectric Ceramics with Field-Induced Transitions: a New Nonlinear Circuit Element.—R. Jaffe. (*Proc. Inst. Radio Engrs*, Aug. 1961, Vol. 49, No. 8, pp. 1264–1267.) Ceramic dielectrics have been prepared which undergo field-induced antiferroelectric–to–ferroelectric transition from below −60°C to over 100°C. The transition is indicated by a D/E hysteresis figure with a linear central region and large showing saturation on either end. Capacitance nonlinearity, energy storage and transducer properties are described.

537.226.1 : 2 : 547.476.3 1815

The Piezoelectricity and Electrostriction of Rochelle Salt.—G. Schmidt. (*Z. Phys.*, 14th Feb. 1961, Vol. 161, No. 3, pp. 379–405.) Detailed report of measurements and discussion of results with particular reference to the ferroelectric anomaly of Rochelle salt.

537.226.1 : 548.518.31 1816

Piezoelectricity of Quartz for Cubic Strain.—S. Machlup & M. E. Christophe. (*J. appl. Phys.*, July 1961, Vol. 32, No. 7, pp. 1387–1391.) Calculation of the principal piezoelectric coefficient using a hard-sphere, rigid-ion model.

537.311.33 1817

Behaviour of the Electrons in Microwave Fields.—B. V. Paranjape. (*Phys. Rev.*, 1st June 1961, Vol. 122, No. 5, pp. 1372–1375.) A theoretical investigation is made of the currents produced by hot electrons when a weak microwave field is superimposed on a strong steady electric field, and also the effect of a strong microwave field alone. An alternating current at the same frequency as the applied field and leading it in phase is produced.

537.311.33 1818

Electron–Electron Scattering and Transport Phenomena in Nonpolar Semiconductors.—J. Appel. (*Phys. Rev.*, 15th June 1961, Vol. 122, No. 6, pp. 1760–1772.) Electron-electron scattering causes electrical conductivity to be reduced less than the electronic heat conductivity. Its influence on electrical conductivity, heat conductivity and the Seebeck coefficient is calculated as a function of temperature, and its effect on transport phenomena is briefly considered.

537.311.33 1819

Alternative Approach to the Solution of Added Carrier Transport Problems in Semiconductors.—J. P. McKelvey, R. L. Longini & T. P. Brody. (*Phys. Rev.*, 1st July 1961, Vol. 123, No. 1, pp. 51–57.) A method is described for computing carrier fluxes by solving the continuity equation in terms of a Green's function.

537.311.33 1820

Mechanism of Impurity Conduction in Semiconductors.—J. Mycielski. (*Phys. Rev.*, 1st July 1961, Vol. 123, No. 1, pp. 99–105.) The conductivity of impurities at low temperatures is discussed in terms of jumps over the Coulomb potential barrier between empty and occupied impurity centres. Calculations relating to anomalies of activation energy are made.

537.311.33 1821

Current-Carrier Transport with Space Charge in Semiconductors.—W. Van Roosbroeck. (*Phys. Rev.*, 15th July 1961, Vol. 123, No. 2, pp. 478–490.) A theory is developed for one-dimensional drift of carriers, taking into account the space charge which can develop in high-resistance materials. The theory is exact for small-signal field variations.

537.311.33 1822

The Scattering of Phonons by Bound Electrons in a Semiconductor.—I. C. Pyle. (*Phil. Mag.*, May 1961, Vol. 6, No. 65, pp. 609–610.)

537.311.33: 538.23 1823

Interaction of Electrons and Helicons with Acoustic Waves in Intrinsic Semiconductors.—N. Mikoshiba. (*J. phys. Soc. Japan*, May 1961, Vol. 16, No. 5, pp. 895–901.) A self-consistent theory is produced which shows that the acoustoelectromotive force is too small to be detected by experiment.

537.311.33: 535.215 1824

On the Study of Volume Recombination of Excess Charge Carriers in Semiconductors with the Aid of Photoconductance.—R. H. Schulte. (*Philips Res. Rep.*, April 1961, Vol. 16, No. 2, pp. 175–181.) By measuring amplitude and phase of photoconductance in different ambients, it is possible in some cases to determine the surface effects, and reliable volume-recombination times can be deduced.

537.311.33: 535.34-15 1825

Contribution of Lattice Scattering between Nonequivalent Valleys to Free-Carrier Infrared Absorption in Semiconductors.—H. Ridley & H. J. G. Meyer. (*Phys. Rev.*, 15th July 1961, Vol. 123, No. 2, pp. 416–419.)

537.311.33: 538.614 1826

The Faraday Effect in Nondegenerate Semiconductors.—B. Donovan & J. Webster. (*Proc. phys. Soc.*, 1st July 1961, Vol. 78, No. 498, pp. 120–132.) The theory of the Faraday effect, in relation to microwave and infrared propagation in semiconductors is developed. Frequency and temperature dependence are investigated for n-type Ge.

537.311.33: 538.63 1827

The Theory of Electrical Conductivity of Semiconductors in a Magnetic Field: Part I.—V. L. Gurevich & Yu. A. Firsov. (*Zh. eksp. teor. Fiz.*, Jan. 1961, Vol. 40, No. 1, pp. 199–213.) A quantum theory of the transverse conductivity of semiconductors in a strong magnetic field is developed, taking account of inelastic scattering of electrons.

537.311.33: 538.63 1828

Galvanomagnetic Effects in Semiconductors at High Electric Fields.—E. M. Conwell. (*Phys. Rev.*, 15th July 1961, Vol. 123, No. 2, pp. 454–463.) A theory of magnetoconductivity for general energy-band structure is evolved in a form convenient for the calculation of Hall coefficients and other galvanomagnetic effects for either low or high electric field strengths.

537.311.33: 538.63 1829

Measurements of the Frequency Dependence of the Ganoe Effect in Various Semiconductors up to 2 000 Mc/s.—M. J. O. Strutt & P. K. van Wilhem. (*Arch. elekt. Übertragung*, Jan. 1961, Vol. 15, No. 1, pp. 25–32.) The Ganoe effect in Corbino disks of Ge, InSb and InAs was measured in the frequency range 0–2 Gc/s as a function of temperature in the range 140°–270°K for flux densities up to 0.46 Wb/m². Pronounced frequency dependence was found above 30 Mc/s. For earlier measurements of this galvanomagnetic effect see (304 of 1957 (Hamer et al.).

537.311.33: 538.23 1830

Field-Enhanced Donor Diffusion in Degenerate Semiconductor Layers.—W. Shockley. (*J. appl. Phys.*, July 1961, Vol. 32, No. 7, pp. 1363–1403.) An expression for the effective diffusion constant is given.

537.311.33: [546.28 + 546.289] : 535.215 1831

Photovoltages in Silicon and Germanium Layers.—H. Kallmann, B. Kramer, E. Haidemenakis, W. J. McAfee, H. Berkemeyer & P. I. Pollak. (*J. electrochem. Soc.*, March 1961, Vol. 108, No. 3, pp. 247–251.) Photovoltages of several thousand volts are observed between electrodes 1 cm

apart when the layers are maintained at liquid-nitrogen temperatures and strongly illuminated. At room temperature, only a few hundred volts were produced. A possible explanation of this effect is suggested.

537.311.33: [546.28 + 546.289] : 621.317.3 (083.7) **3832**

I.R.E. Standards on Solid-State Devices: Measurement of Minority-Carrier Lifetime in Germanium and Silicon by the Method of Photoconductive Decay.—(*Proc. Inst. Radio Engrs*, Aug. 1961, Vol. 49, No. 8, pp. 1292–1299.) Standard 61 I.R.E. 28.S2.

537.311.33: 546.28 **3833**

The Formation of Dislocation-Free Silicon Single Crystals.—G. Ziegler. (*Z. Naturf.*, Feb. 1961, Vol. 16a, No. 2, p. 219.) The configuration of dislocations in thin Si rods is investigated to obtain insight into the mechanism of dislocation reduction.

537.311.33: 546.28 **3834**

Low-Frequency Conductivity due to Hopping Processes in Silicon.—M. Pollak & T. H. Geballe. (*Phys. Rev.*, 15th June 1961, Vol. 122, No. 6, pp. 1742–1753.) The complex conductivity has been measured in *n*-type Si with various kinds of impurities at frequencies between 100 c/s and 10 kc/s in the temperature range 1–20°K. In most cases it is several orders of magnitude higher than the measured d.c. conductivity; this is attributed to polarization caused by hopping processes. A simple theory is derived which is in good agreement with the observed variation of conductivity with frequency and concentration.

537.311.33: 546.28 **3835**

Hot-Electron Emission from Silicon *p-n* Junctions Parallel to the Surface.—J. L. Moll, N. I. Meyer & D. J. Bartelink. (*Phys. Rev. Lett.*, 1st Aug. 1961, Vol. 7, No. 3, pp. 87–90.) Experimental results are presented and compared with theoretical expressions which take into account the important types of interaction between the hot electrons and the crystal lattice.

537.311.33: 546.28 **3836**

Forward Characteristics of Si *p-π-n* Junctions.—M. Tokunaga & K. Shono. (*J. phys. Soc. Japan*, May 1961, Vol. 16, No. 5, pp. 1029–1030.) A series of junctions were prepared in *p*-type Si crystals of resistivity 2–5 Ω.cm, by diffusing B from one side and P from the other side of the crystal. *I/V* characteristics of junctions with π regions of different width are shown and discussed.

537.311.33: 546.289 **3837**

Electronic Effect in the Elastic Constants of Germanium.—L. J. Bruner & R. W. Keyes. (*Phys. Rev. Lett.*, 15th July 1961, Vol. 7, No. 2, pp. 55–56.) A measured change in one of the elastic constants (C_{44}) of Ge when heavily doped with As is reported.

537.311.33: 546.289 **3838**

Electric-Field-Induced Modulation of the Absorption due to Interband Transitions of Free Holes in Germanium.—M. A. C. S. Brown & E. G. S. Paige. (*Phys. Rev. Lett.*, 1st Aug. 1961, Vol. 7, No. 3, pp. 84–86.) Observations were made of the change in absorption due to a change in the distribution function of the free holes. Experimental data are given and discussed.

537.311.33: 546.289 **3839**

Anodic Oxidation of Germanium.—T. Gabor. (*J. appl. Phys.*, July 1961, Vol. 32, No. 7, pp. 1361–1363.) "On anodic polarization of etched samples of *n*-type or near-intrinsic *p*-type germanium, striations are formed. The periodic depletion of holes is advanced as a tentative explanation of the phenomenon."

537.311.33: 546.289 **3840**

A Study of Growth Processes in Germanium Dendrites using Pulse Electroplating Techniques.—R. C. Smith. (*J. electrochem. Soc.*, March 1961, Vol. 108, No. 3, pp. 238–241.) Separate mechanisms for axial and lateral growth have been identified. The observed resistivity boundary lines are due to the lateral growth mechanism.

537.311.33: 546.289 **3841**

Influence of Wet and Dry Ambients on Fast Surface States of Germanium.—Y. Margoninski & H. E. Farnsworth. (*Phys. Rev.*, 1st July 1961, Vol. 123, No. 1, pp. 135–140.) A specimen of *n*-type Ge was subjected to different gaseous environments. The effects of N_2, O_2 and water vapour on the surface states can be discussed separately.

537.311.33: 546.289 **3842**

Determination of the Coefficient of Diffusion of Arsenic in Germanium by Measurement of the Thermoelectric Voltage.—E. Batifol & G. Duraffourg. (*J. Phys. Radium*, Nov. 1960, Vol. 21, Supplement to No. 11, *Phys. appl.*, pp. 207A–216A.) The surface concentration of As is obtained by measurement of (*a*) thermoelectric power, (*b*) sheet resistance. The mean value of the diffusion coefficient at 800°C is $1{\cdot}3 \times 10^{-11}$ cm²/s.

537.311.33: 546.289 **3843**

Recombination at Copper and at Nickel Centres in *p*-Type Germanium.—B. H. Schultz. (*Philips Res. Rep.*, April 1961, Vol. 16, No. 2, pp. 182–186.) An explanation is given for the different temperature dependence of recombination rates at Cu centres for partly compensated and noncompensated crystals. No solution could be found for the discrepancies which occur with Ni.

537.311.33: 546.289 **3844**

Effect of Temperature and Doping on the Reflectivity of Germanium in the Fundamental Absorption Region.—M. Cardona & H. S. Sommers, Jr. (*Phys. Rev.*, 1st June 1961, Vol. 122, No. 5, pp. 1382–1388.)

537.311.33: 546.289: 538.63 **3845**

Longitudinal Magnetoresistance in *n*-Type Germanium: Experimental.—W. F. Love & W. F. Wei. (*Phys. Rev.*, 1st July 1961, Vol. 123, No. 1, pp. 67–73.) Curves showing the variation of the magnetoresistance ratio with magnetic field and temperature, in fields up to 300 kG and temperature from 20°K to 300°K, are presented and discussed.

537.311.33: 546.289: 538.63 **3846**

Longitudinal Magnetoresistance in *n*-Type Germanium: Theoretical.—S. C. Miller & M. A. Omar. (*Phys. Rev.*, 1st July 1961, Vol. 123, No. 1, pp. 74–80.) Calculations of acoustic scattering give satisfactory agreement with the experimental results at high field strengths (3845 above).

537.311.33: 546.289: 621.391.822 **3847**

Slow Decay of Reverse Current and Noise in Field Effect on Ge p^+-n Junction.—H. Edagawa, Y. Morita, S. Maekawa & Y. Inuishi. (*J. phys. Soc. Japan*, May 1961, Vol. 16, No. 5, pp. 1041–1042.) Current and noise measurements were made simultaneously at the junctions; results are presented in graphical form.

537.311.33: 546.289: 621.391.822 **3848**

Recombination Noise of Germanium Single Crystals in the Range of Defect Semiconduction.—M. Pilkuhn. (*Z. Naturf.*, Feb. 1961, Vol. 16a, No. 2, pp. 173–182.) The frequency dependence of recombination noise was investigated in the range 100 c/s–500 kc/s for various contact arrangements and specimen surfaces. Also investigated were the temperature characteristics of noise in the range 6–15°K, and the dependence on field strength of the spectral distribution function of noise.

537.311.33: 546.289: 621.391.822 **3849**

Fluctuation Phenomena in the Formation of Impact Ionization Avalanches in Ge Single Crystals between 5° and 10°K.—M. Pilkuhn. (*Z. Naturf.*, Feb. 1961, Vol. 16a, No. 2, pp. 182–187.) The increase of noise observed during low-temperature breakdown in Ge is shown to be due to recombination effects. See also 3848 above.

537.311.33: 546.47'241 **3850**

The Electrical Properties of Zinc Telluride.—H. Tubota, H. Suzuki & K. Hirakawa. (*J. phys. Soc. Japan*, May 1961, Vol. 16, No. 5, pp. 1038–1039.) The electrical resistivities and Hall coefficients of stoichiometric and Sb- or In-doped samples are given in graphical form.

537.311.33: 546.681'18 **3851**

The Preparation and Floating-Zone Processing of Gallium Phosphide.—C. J. Frosch & L. Derick. (*J. electrochem. Soc.*, March 1961, Vol. 108, No. 3, pp. 251–257.)

537.311.33: [546.682'19 + 546.682'18 **3852**

Infrared Cyclotron Resonance in *n*-Type InAs and InP.—E. D. Palik & R. F. Wallis. (*Phys. Rev.*, 1st July 1961, Vol. 123, No. 1, pp. 131–134.)

537.311.33: 546.682'86 **3853**

Anisotropic Segregation in InSb.—W. P. Allred & R. T. Bate. (*J. electrochem. Soc.*, March 1961, Vol. 108, No. 3, pp. 258–261.)

537.311.33: 546.682'86 **3854**

Pinch Effect in Indium Antimonide.—A. G. Chynoweth & A. A. Murray. (*Phys. Rev.*, 15th July 1961, Vol. 123, No. 2, pp. 515–520.) A critical current of 4–5 A for the occurrence of pinch effect in InSb was measured by three different experimental methods.

537.311.33: 546.682'86: 535.215 **3855**

Properties and Applications of Indium Antimonide.—R. E. J. King & B. R. Bartlett. (*Philips tech. Rev.*, 5th April 1961, Vol. 22, No. 7, pp. 217–225.) The preparation of InSb crystals and the construction and performance of photocells based on InSb are described.

537.311.33: 546.682'86: 535.215 **3856**

Oscillatory Photoconductivity in InSb.—W. Engeler, H. Levinstein & C. Stannard, Jr. (*Phys. Rev. Lett.*, 15th July 1961, Vol. 7, No. 2, pp. 62–63.) Cu, Ag, Au and Ni were added to InSb, and an oscillating curve was obtained for the photoconductive response as a function of incident wavelength at liquid-helium temperatures. The oscillations are attributed to the emission of successive longitudinal optical phonons.

537.311.33: 546.682'86: 538.632 **3857**

Corbino-Disk Magnetoresistivity Measurements on InSb.—M. Green. (*J. appl. Phys.*, July 1961, Vol. 32, No. 7, pp. 1286–1289.)

537.311.33: 546.811-17: 538.63 **3858**

Magnetoresistance of Oriented Gray Tin Single Crystals.—O. N. Tufte & A. W. Ewald. (*Phys. Rev.*, 1st June 1961, Vol. 122, No. 5, pp. 1431–1436.) The low-field magnetoresistance coefficients were evaluated from measurements on *n*- and *p*-type crystals at 77, 195 and 273°K. An explanation is given of the anisotropy observed in *n*-type crystals at 195 and 273°K.

537.311.33: 546.824-31 **3859**

Nonohmic Behaviour in Near-Stoichiometric Rutile (TiO_2).—E. H. Greener & D. H. Whitmore. (*J. appl. Phys.*, July 1961, Vol. 32, No. 7, pp. 1320–1324.) Increase in ambient specimen temperature requires a higher field for the transition from ohmic to nonohmic behaviour. At 908°C only ohmic currents are exhibited at the highest field strength used (10 V/cm).

537.311.33: 546.824-31: 537.323 **3860**

Thermoelectric Behaviour of Rutile.—K. Sakata. (*J. phys. Soc. Japan*, May 1961, Vol. 16, No. 5, p. 1026.) Thermo-e.m.f. and conductivity have been measured as functions of temperature for samples sintered in O_2 at different pressures.

537.311.33: 621.317.33 **3861**

Contactless Resistivity Meter for Semiconductors.—J. C. Brice & P. Moore. (*J. sci. Instrum.*, July 1961, Vol. 38, No. 7, p. 307.) Resistivity is determined as a function of the eddy currents induced in the specimen by a 10-Mc/s oscillator. Resultant amplitude changes in the oscillator output are measured with a valve voltmeter.

537.311.33: 669: 061.3 **3862**

New Techniques for Producing Ultrapure Semiconductors.—T. Maguire. (*Electronics*, 7th July 1961, Vol. 34, No. 27, pp. 41–45.) A review is given of the papers presented at the conference on ultrapurification of semiconductor materials, held at Boston, U.S.A.

537.312.62 **3863**

Magnetic Properties of Thin Superconducting Tin and Indium Films.—R. E. Sewell'yanov. (*Zh. eksp. teor. Fiz.*, Nov. 1961, Vol. 40, No. 1, pp. 52–63.) The conditions for the absence of the normal phase in a superconducting film of finite size arranged at a small angle to a uniform magnetic field are determined. The dependence of the transverse component of the magnetic moment M on the temperature and thickness is determined for tin and indium films of thickness 4×10^{-6}–2×10^{-4} cm.

537.312.62: 538.222 **3864**

Differential Paramagnetic Effect in Superconductors.—R. A. Hein & R. L. Falge, Jr. (*Phys. Rev.*, 15th July 1961, Vol. 123, No. 2, pp. 407–415.)

537.312.62: 539.23 **3865**

Size Effects in Thin Superconducting Indium Films.—A. M. Toxen. (*Phys. Rev.*, 15th July 1961, Vol. 123, No. 2, pp. 442–446.)

538.221 **3866**

Distribution of the Magnetization in a Ferromagnet.—M. W. Muller. (*Phys. Rev.*, 1st June 1961, Vol. 122, No. 5, pp. 1485–1489.) Analysis provides evidence that a stable nonuniform distribution is produced in a thick ferromagnetic slab in a large applied field, and that domains can appear if the anisotropy field is smaller than the demagnetizing field.

538.221 **3867**

Change of Thermal and Electrical Conductivity of Ferromagnetic Materials in a Magnetic Field.—H. Papadimitraki. (*Z. Naturf.*, Feb. 1961, Vol. 16a, No. 2, p. 217.) Summary of experimental results obtained with Ni; the Lorentz number is plotted as a function of field strength over the range 0–4 000 oersteds. Effects in Fe are too small to obtain quantitative results.

538.221 **3868**

Weak Field Behaviour of the ΔE Effect in Ferromagnetic Cubic-Solid-Solution Alloys.—M. Yamamoto & S. Taniguchi. (*J. phys. Soc. Japan*, May 1961, Vol. 16, No. 5, pp. 1035–1036.)

538.221 **3869**

Magnetic Properties of Sintered Iron.—H. Dietrich. (*Z. Metallkde*, April 1961, Vol. 52, No. 4, pp. 232–235.) Magnetic data of unalloyed sintered iron are tabulated and the dependence of the characteristics on the manufacturing process and heat treatment is illustrated.

538.221 **3870**

On the Influence of the Formation of Subgrain Structures on the Magnetic Properties of Pure Iron.—G. Montalenti & C. Sari. (*Nuovo Cim.*, 1st Feb. 1961, Vol. 19, No. 3, pp. 605–608.) The formation of extremely stable subgrain structures which cannot be removed by further heat treatment, reduces considerably the permeability of iron specimens.

538.221 **3871**

Ferromagnetism in Solid Solutions of Scandium and Indium.—B. T. Matthias, A. N. Clogston, H. J. Williams, E. Corenzwit & R. C. Sherwood. (*Phys. Rev. Lett.*, 1st July 1961, Vol. 7, No. 1, pp. 7–9.)

538.221 **3872**

Magnetic Anisotropy and Rotational Hysteresis in Single Crystals of Magnetite Below the Transition Temperature.—R. F. Pearson & R. Cooper. (*Proc. phys. Soc.*, 1st July 1961, Vol. 78, No. 499, pp. 17–24.) Results of torque measurements, with some theoretical discussion.

538.221 **3873**

Magnetization of Nickel Single Crystals.—L. Tterlikkis & A. W. Jenkins, Jr. (*J. appl. Phys.*, July 1961, Vol. 32, No. 7, pp. 1293–1296.) Anisotropy coefficients are calculated from experimental curves. A possible method of measuring internal strain energy is suggested.

538.221 **3874**

Magnetic Anisotropy of Heusler Single Crystal.—K. Aoyagi & M. Sugihara. (*J. phys. Soc. Japan*, May 1961, Vol. 16, No. 5, p. 1027.) Experimental details of the growth and ferromagnetic properties of a crystal of Cu_2MnAl.

538.221: 537.533.72 **3875**

An Electron-Optical Method for the Measurement of the State of Magnetization of Ferromagnetic Specimens.—C. Schwink. (*Z. Phys.*, 14th Feb. 1961, Vol. 161, No. 5, pp. 560–578.) The feasibility of electron-optical measurements of magnetization is investigated theoretically for a cylinder with gap system [see also 1256 of April (Murrmann & Schwink)].

538.221: 539.23 **3876**

The Preparation of Continuous Single-Crystal Thin Films of Nickel and Nickel-Iron Alloys.—O. S. Heavens, R. F. Miller, G. L. Moss & J. C. Anderson. (*Proc. phys. Soc.*, 1st July 1961, Vol. 78, No. 499, pp. 33–37.)

538.221: 539.23 **3877**

Magnetic Anisotropy in Single-Crystal Nickel Films.—J. C. Anderson. (*Proc. phys. Soc.*, 1st July 1961, Vol. 78, No. 499, pp. 25–32.)

538.221: 539.23 **3878**

Field-Induced and Angle-of-Incidence Anisotropy in Nickel-Iron Films.—E. Feldtkeller. (*Z. angew. Phys.*, Feb. 1961, Vol. 13, No. 2, pp. 74–76.) The magneto-optical Faraday effect is used to determine the contours of anisotropy orientation and field strength, and of the wall coercivity.

538.221: 539.23: 538.61 **3879**

The Kerr Hysteresis Effect: a Phenomenon of Surface Magnetization.—J. Kranz & B. Passon. (*Z. Phys.*, 14th Feb. 1961, Vol. 161, No. 5, pp. 525–538.) Surface-magnetization curves for Fe-Si single crystals are obtained with the aid of the Kerr effect. See also 1281 of 1959 (Kranz & Drechsel).

538.221: 539.23: 538.614 **3880**

Observations of Cross-Tie Domain Walls by the Faraday Effect.—A. L. Houde. (*J. appl. Phys.*, July 1961, Vol. 32, No. 7, pp. 1234–1237.) An apparatus for observation of the microscopic Faraday effect is described. The fine structure of the domain configurations in thin permalloy films has been observed.

538.221 : 539.23 : 621.385.833 **3881**

Transmission - Electron - Microscope Observations of Magnetic Domain Walls.—J. T. Michalak & R. C. Glenn. (*J. appl. Phys.*, July 1961, Vol. 32, No. 7, pp. 1261–1265.) This technique for domain studies complements other techniques and is especially valuable for investigating magnetic films.

538.221 : 621.318.134 **3882**

The Theory of the High-Frequency Magnetic Susceptibility of Ferrodielectrics at Low Temperatures.—I. A. Akhiezer, V. G. Bar'yakhtar & S. V. Peletminskii. (*Zh. eksp. teor. Fiz.*, Jan. 1961, Vol. 40, No. 1, pp. 365–374.) The transverse components of the susceptibility tensor of a ferrite are calculated using methods of quantum field theory and taking both exchange and relativistic interactions between spin waves into account, and the ferromagnetic resonance line width is determined.

538.221 : 621.318.134 **3883**

A Note on the Electron Diffusion and the Wall Relaxation in Ferrites.—H. Sekizawa. (*J. phys. Soc. Japan*, May 1961, Vol. 16, No. 5, pp. 1034–1035.) The distinction between the relaxation times due to the motion of electrons and wall relaxation is established.

538.221 : 621.318.134 : 538.652 **3884**

Theory of Magnetostriction in Cobalt-Manganese Ferrite.—J. C. Slonczewski. (*Phys. Rev.*, 1st June 1961, Vol. 122, No. 5, pp. 1367–1372.)

538.221 : 621.318.4.042.1 : 534.2-8 **3885**

Studies of Magnetization Processes of Magnetic Cores by Supersonic Methods.—K. Nishiguchi & H. Sawabe. (*Rec. elect. Commun. Lab., Japan*, March/April 1961, Vol. 9, Nos. 3/4, pp. 207–213.) When an ultrasonic vibration is applied to a magnetic core, the voltage output induced in a winding on the core is proportional to the remanent flux. This principle is applied to nondestructive investigation of the inner structure of magnetic cores.

538.221 : 621.318.57 **3886**

Two-Phase Permalloy for High-Speed Switching.—E. A. Nesbitt & E. M. Gyorgy. (*J. appl. Phys.*, July 1961, Vol. 32, No. 7, pp. 1305–1308.) Gold added to permalloy makes precipitation of a second phase possible; coercive force and the threshold of rotational flux reversal can thus be controlled. Switching cores of such material are four times faster than standard cores.

538.22 **3887**

Abrupt Magnetic Transition in $MnSn_2$.—J. S. Kouvel & C. C. Hartelius. (*Phys. Rev.*, 1st July 1961, Vol. 123, No. 1, pp. 124–125.)

539.2 : 538.569.4 **3888**

Spin-Lattice Relaxation in Imperfect Cubic Crystals and in Noncubic Crystals.—E. R. Andrew & D. P. Tunstall. (*Proc. phys. Soc.*, 1st July 1961, Vol. 78, No. 499, pp. 1–11.)

548.5 : 535.215 **3889**

Vapour-Phase Growth of Single Crystals of II-VI Compounds.—W. W. Piper & S. J. Polich. (*J. appl. Phys.*, July 1961, Vol. 32, No. 7, pp. 1278–1279.)

669.018.5 : 537.311.33 **3890**

Capillary Alloying: an Improved Alloying Method.—K. Lehovec, K. Busen, J. Casey, C. Pochop & A. Webb. (*J. electrochem. Soc.*, March 1961, Vol. 108, No. 3, pp. 241–247.) Extremely flat, uniformly alloyed metal/semiconductor junctions can be produced with a separation from the wafer surface of less than 0·25 μ. Advantages of the technique over pellet alloying are the high degree of purity of the liquid alloy surface before alloying, and the possibility of comparing alloy compositions conveniently.

MATHEMATICS

512 : 621.318.57 : 681.142 **3891**

Symbolic Logic.—B. R. Wilkins. (*Electronic Technol.*, Sept. 1961, Vol. 38, No. 9, pp. 317–324.) Elements of Boolean algebra and Venn diagrams are explained and their applications to verbal statements and to switching and computer circuits are considered.

517.941 **3892**

Six 'Natural' Normalizations of the Characteristic Equation of Third Degree.—E. Schwartz. (*Arch. elekt. Übertragung*, Feb. 1961, Vol. 15, No. 2, pp. 94–100.) With the aid of the normalized equations and diagrams derived the location of the roots in the complex plane can be determined; this leads to the solution of the linear homogeneous differential equation of third order on which the characteristic equation is based.

517.942.82 **3893**

A Theorem of the Laplace Transformation.—G. Fodor. (*Period. polyt., Hp., Elect. Engng*, 1961, Vol. 5, No. 1, pp. 41–56. In German.) The problem of dealing with the Laplace transform of the derivative of a discontinuous function is considered. The method of solution proposed simplifies practical application.

517.942.82 **3894**

The Solution of Ordinary and Partial Differential Equations by means of the One- and Multi-dimensional Laplace Transformation for Limited Ranges.—A. Käch. (*Arch. elekt. Übertragung*, Jan. 1961, Vol. 15, No. 1, pp. 33–47.)

MEASUREMENTS AND TEST GEAR

529.78 : 621.317.755 **3895**

Precise Measurement of a Time Interval of the Order of One Microsecond.—J. Bourguignon. (*J. Phys. Radium*, Nov. 1960, Vol. 21, Supplement to No. 11, *Phys. appl.*, pp. 217A–218A.) A simple modification of normal oscillographic technique is described, giving a triangular-waveform display with marker traces. Accuracy of the order of 5 ns is obtained.

621.3.018.41(083.74) **3896**

A Magnetic Shield for Beam Frequency Standards.—F. S. Barnes. (*Proc. Inst. Radio Engrs*, Aug. 1961, Vol. 49, No. 8, p. 1328.) To reduce the frequency uncertainty of caesium-beam frequency standards, caused by stray e.m. fields, a magnetic shield of superconducting material is proposed instead of the more usual mumetal.

621.317(083.74) **3897**

Measurement and Standardization.—J. Cassassolles. (*Rev. gén. Elect.*, April 1961, Vol. 70, No. 4, pp. 201–207.) A review of the work done by the Union technique de l'Électricité (U.T.E.) on standardization of methods of measurement, measuring equipment and different reference standards.

621.317.029.6 : 541.135 + 621.318.134 **3898**

New Methods of Studying Concentrated Electrolytes and Ferromagnetic Oxides at Very Short Wavelengths.—J. C. Lestrade. (*Rev. gén. Elect.*, Feb. 1961, Vol. 70, No. 2, pp. 99–122.) Techniques of measurement at frequencies up to 4 Gc/s are described and results of measurements of the permittivity of several concentrated electrolytic solutions and the gyromagnetic resonance of γ-Fe_2O_3 and Fe_3O_4 are presented. An interpretation of observed phenomena is given. 62 references.

621.317.081.6 (083.74) **3899**

The Origin of International Electrical Units and their Present Situation.—R. Hérold. (*Rev. gén. Elect.*, March 1961, Vol. 70, No. 3, pp. 222[illegible]–236[illegible].) A brief history is given of the development of electrical standards and the definitions of the standard ohm, volt and ampere adopted by international committees from 1881 to 1948 are tabulated.

621.317.332.6.029.6 **3900**

Measurement of Low Reflection Coefficients at High Frequencies.—K. Kohler. (*Frequenz*, Jan. 1961, Vol. 15, No. 1, pp. 12–17.) The principle of the method which is applicable to coaxial systems and waveguides is described. A commercial-type directional coupler with a quadripole tuned by stubs is used. See also 3367 of 1958 (Linnebach).

621.3.17.373 : 621.3.018.783 **3901**

The Effect of Nonlinear Distortion on Errors in Measuring the Phase Shift between Two Voltages.—B. G. Kadish. (*Izmer. Tekh.*, June 1961, No. 6, pp. 44–45.) Formulae applicable to the measurement of phase difference are derived.

621.317.4 : 538.221 : 539.23 **3902**

Method for Measuring the Anisotropy Function of Thin Magnetic Films.—T. D. Rossing & R. Sinden. (*Rev. sci. Instrum.*, June 1961, Vol. 32, No. 6, pp. 752–753.) A simple apparatus is described in which the a.c. field coil and pick-up coil can be rotated together. The method gives a more accurate value for the anisotropy field than the usual hysteresis method.

621.317.725.029.5/.6 **3903**

Measuring Low-Level R.F. Voltage with Servo Feedback Techniques.—T. C. Anderson. (*Electronics*, 14th July 1961, Vol. 34, No. 28, pp. 63–65.) A millivoltmeter is described which has seven voltage ranges, covering 10 mV to 10 V r.m.s., and operates over the frequency range 500 kc/s –1 Gc/s.

621.317.733.011.22 **3904**

A Precision Conductance Bridge of New Design.—G. J. Janz & J. D. E. McIntyre. (*J. electrochem. Soc.*, March 1961, Vol. 108, No. 3, pp. 272–276.) The bridge is designed for construction from standard commercially available components. The 'four-leads' cell technique eliminates lead effects in remote conductance measurements.

621.317.738 **3905**

Measurements of the Dielectric Properties of Lossy Materials.—E. Groubert & P. Caillon. (*J. Phys. Radium*, Nov. 1960, Vol. 21, Supplement to No. 11, *Phys. appl.*, pp. 155A–160A.) Apparatus for determining the dielectric properties of insulating materials at h.f. is described. Measurement is based on the variation of the width of the resonance curve of a tuned circuit when an impedance is placed across it.

621.317.77 **3906**

Construction of a High-Frequency Phase Meter.—D. Bouvard. (*J. Phys. Radium*, Feb. 1961, Vol. 22, Supplement to No. 3, *Phys. appl.*, pp. 69A–71A.) The meter was designed to measure accurately the phase difference between two points on a conductor system in a linear accelerator. It has a range +60° to −15° and an accuracy within 0·5°.

OTHER APPLICATIONS OF RADIO AND ELECTRONICS

535.376 : 681.142 **3907**

The Electroluminescent Matrix for Pattern Display and Recording.—D. C. Jeffreys & G. R. Hoffman. (*J. Brit. Instn Radio Engrs*, July 1961, Vol. 22, No. 1, pp. 53–64.) The photographic etching technique and vacuum deposition method of forming the matrix are described and a method of extending the lifetime of electroluminescent layers is noted. Selection problems in this type of matrix system are considered.

621.385.833 **3908**

The Resolving Power of Spherically Corrected Electrostatic Electron Microscopes.—W. E. Meyer. (*Optik*, Stuttgart, 1961, Vol. 18, No. 2, pp. 69–91.) The theoretical limit of resolution is calculated and methods of reducing aberration due to misalignments are given.

PROPAGATION OF WAVES

621.391.812.61.029.63 **3909**

Effect of Polarization on the Attenuation by Rain at Millimetre Wavelength.—S. Okamura, K. Funakawa, H. Uda, J. Kato & T. Oguchi. (*J. Radio Res. Labs, Japan*, March 1961, Vol. 8, No. 36, pp. 73–80.) The attenuation of vertically and horizontally polarized waves is compared using a method for rapidly switching the polarization. It is shown that the attenuation is generally larger for horizontally polarized waves. The measurements are in reasonable agreement with the theoretical calculations of Oguchi (1977 of June).

621.391.812.624.029.64 **3910**

Antenna Siting Tests at 3 480 and 9 640 Mc/s on a 173-Mile Tropospheric Scatter Path.—N. D. La Frenais & W. J. Lucas. (*Proc. Inst. Radio Engrs*, Aug. 1961, Vol. 49, No. 8, pp. 1325–1326.) Signal recordings made at a favourable and an unfavourable receiving site are compared. Analysis shows how the difference in signal levels measured at the two sites varied as a function of the system transmission loss. The figures for the dependence on the angular path distances show a dependence of θ^4 instead of the normally accepted θ^5. See 685 of February (Geiger et al.).

621.391.812.63 **3911**

Simple Graphical Procedure for Calculating Sky-Wave Field Intensities.—K. C. Chadha. (*J. Instn Telecommun. Engrs, India*, March 1961, Vol. 7, No. 2, pp. 89–102.) A series of graphical methods of applying the procedures N.P.L.M. [see 190 of 1958 (Rawer)] and R.P.U.9 (*U.S. Army Signal Corps Report*, No. 9) considerably reduce the labour involved but maintain the accuracy of the systems.

621.391.812.63 **3912**

Diversity Effects in Long-Distance High-Frequency Radio Pulse Propagation.—S. S. Bowhill. (*J. Res. nat. Bur. Stand.*, May/June 1961, Vol. 65D, No. 3, pp. 213–225.) Description of spaced-aerial measurements on an 8 600-km path between Ceylon and England using pulsed radio signals. Interpretation of results in terms of E- and F-region multiple reflections gives good correlation with observed delay on the echoes received. The results also indicated that most of the diversity arises through phase incoherence between various orders of reflection.

621.391.812.63 **3913**

Space Analysis of Radio Signals.—J. B. Smyth. (*J. Res. nat. Bur. Stand.*, May/June 1961, Vol. 65D, No. 3, pp. 295–297.) An aerial is represented as a space-frequency filter. The e.f. field generated by it is distorted in passing into the ionosphere, generating new space frequencies, which are the information contained in the field at the receiving aerial.

621.391.812.63 **3914**

Transequatorial Back-Scatter Observations of Magnetically Controlled Ionization.—J. A. Thomas. (*Nature, Lond.*, 19th Aug. 1961, Vol. 191, No. 4790, p. 782.) Very-long-range transequatorial echoes have been observed at Brisbane with a 16-Mc/s narrow-beam rotating-aerial back-scatter equipment [3371 of 1960 (Thomas & McNicol)]. They occur on 95% of afternoons and are attributed to the ionospheric-tilt chordal-hop mechanism proposed by Villard et al. (244 of 1958).

621.391.812.63 : 621.396.663 **3915**

Propagation Studies Using Direction-Finding Techniques.—E. C. Hayden. (*J. Res. nat. Bur. Stand.*, May/June 1961, Vol. 65D, No. 3, pp. 197–212.) Two methods are described for the study of direction of arrival of individual components of multi-path signals, resolution being undertaken by 'time of arrival' separation for pulse transmissions or by 'direction of arrival' separation using a highly directional aerial system. Some results obtained in studies of reception on 5·155 Mc/s over a path of 450 km and on 10 Mc/s over a path of 1 000 km are presented.

621.391.812.63.029.4/.5 **3916**

Comparison between Mode Theory and Ray Theory of V.L.F. Propagation.—H. Volland. (*J. Res. nat. Bur. Stand.*, July/Aug. 1961, Vol. 65D, No. 4, pp. 357–361.) Values of field strength according to mode theory and ray theory in the v.l.f. band are derivable from the same expression of the original vector potential, the result of one theory being the analytic continuation of the other one in another range of convergence. Both theories give the same result between distances of 300 km and 2 000 km. The relation to lightning discharges is considered.

621.391.812.63.029.45 **3917**

Statistics of a Radio Wave Diffracted by a Random Ionosphere.—S. A. Bowhill. (*J. Res. nat. Bur. Stand.*, May/June 1961, Vol. 65D, No. 3, pp. 275–282.) Mathematical methods for evaluating the statistical properties of a random signal diffracted in free space are applied to the random structure of the lower ionosphere at very low frequencies. Allowance is made for sphericity, and anisotropy in the signal variations is permitted.

621.391.812.63.029.45 **3918**

Excitation of V.L.F. and E.L.F. Radio Waves by a Horizontal Magnetic Dipole.—J. Galejs. (*J. Res. nat. Bur. Stand.*, May/June 1961, Vol. 65D, No. 3, pp. 305–311.) The v.l.f. and e.l.f. modes excited by a horizontal magnetic dipole in the shell between a finitely conducting earth and an isotropic ionosphere are shown to have an almost transverse magnetic character. Response of the zero-order mode of the magnetic dipole has been calculated.

621.391.812.63.029.53 **3919**

Characteristics of Ionospheric Waves in the M.F. Band Measured at Night by the Vertical-Incidence Method.—S. Hasegawa & T. Kobayashi. (*J. Radio Res. Labs, Japan*, March 1961, Vol. 8, No. 36, pp. 127–136.) Observations of virtual heights and field intensities on frequencies of 540, 1 040 and 1 440 kc/s are described. During summer the one-hop-E mode is predominant over the full frequency range, while in autumn and winter the one-hop-F mode is more important above 1 Mc/s.

621.391.812.63.029.62 **3920**

Effect of E_s on V.H.F. Pulse Wave Propagation.—K. Aida, T. Koseki & K. Uchikura. (*J. Radio Res. Labs, Japan*, March 1961, Vol. 8, No. 36, pp. 117–126.) Observations of v.h.f. propagation over a

path of 960 km and vertical soundings near the path mid-point show that during the day, propagation occurs via the E_s layer but during the night, reflection from meteoric dust is more important.

621.391.812.63.029.62 **3921**

Influence of Types of E_s Layer on E_s-Layer Propagated Waves.—A. Sakurazawa. (*J. Radio Res. Labs, Japan*, March 1961, Vol. 8, No. 36, pp. 97–116.) The factors governing E_s-layer propagation are examined by comparing v.h.f. observations over a 1 100-km path with those of E_s at the path mid-point. The analysis shows that the reflecting efficiency of the E_s layer depends on the values of f_0E_s over an area about the mid-point. The attenuation due to the D region is negligible while that due to the E region is most noticeable for propagation via the 'h' type E_s.

RECEPTION

621.376.33 : 621.396.43 **3922**

Project Echo: F.M. Demodulators with Negative Feedback.—C. L. Ruthroff. (*Bell Syst. tech. J.*, July 1961, Vol. 40, No. 4, pp. 1149–1156.) The performance of a f.m. receiver is described in which the beating oscillator is made to follow the instantaneous frequency of the signal. A smaller i.f. bandwidth can then be used which results in a better signal/noise ratio than can be obtained with a conventional f.m. receiver or with s.s.b. techniques.

621.391.82 **3923**

On the Theory of Amplitude Distribution of Impulsive Random Noise.—K. Furutsu & T. Ishida. (*J. appl. Phys.*, July 1961, Vol. 32, No. 7, pp. 1206–1221.) Two models are considered and treated mathematically, one for Poisson noise (e.g. electronic noise) and the other for Poisson-Poisson noise (e.g. atmospheric noise). Theoretical distributions are compared with actual atmospheric noise.

621.391.82(545.5) **3924**

Measurements of Radio Noise in the Delhi Area: Part 1.— N. B. Bhatt, M. K. Gupta & Y. S. N. Murty. (*Def. Sci. J.*, Jan. 1961, Vol. 11, No. 1, pp. 23–33.) Noise levels measured in and near Delhi in the frequency range 150 kc/s–21 Mc/s show little correlation with the C.C.I.R. predictions. The diurnal variation was much smaller than expected.

621.391.821 : 621.396.62 **3925**

Effect of Receiver Bandwidth on the Amplitude Distribution of V.L.F. Atmospheric Noise.—F. F. Fulton, Jr. (*J. Res. nat. Bur. Stand.*, May/June 1961, Vol. 65D, No. 3, pp. 299–304.) For an assumed three-term parametric-exponential equation relating cumulative amplitude probability to field-strength threshold, expressions are derived indicating parameter variation as a function of bandwidth.

621.396.62 : 621.396.43 **3926**

Project Echo: Receiving System.—E. A. Ohm. (*Bell Syst. tech. J.*, July 1961, Vol. 40, No. 4, pp. 1065–1094.) An overall system noise temperature of about 20°K was obtained at 2 390 Mc/s by combining a horn-reflector aerial, maser preamplifier and special f.m. demodulator.

621.396.62 : 621.396.43 **3927**

Project Echo: Standby Receiver System.—L. U. Kibler. (*Bell Syst. tech.J.*, July 1961, Vol. 40, No. 4, pp.1129–1147.)

621.396.621 **3928**

Receivers with Zero Intermediate Frequency.—M. D. Rubin. (*Proc. Inst. Radio Engrs*, Aug. 1961, Vol. 49, No. 8, pp. 1327–1328.) An outline of the advantages and disadvantages of using a zero intermediate frequency. See e.g. 1677 of 1959 (Greene & Lyons) and 2767 of August (Casey).

621.396.621.072.6 : 621.391.82 **3929**

The Effect of Interference on an Automatic Frequency Control System: Part 1.—V. I. Kaganov & N. S. Nemirovskii. (*Radiotekhnika i Elektronika*, Sept. 1960, Vol. 5, No. 9, pp. 1380–1386.) An analysis of the effect of noise on an a.f.c. system comprising an ideal discriminator, the mean frequency of which is not zero, operating with and without an i.f. filter.

STATIONS AND COMMUNICATION SYSTEMS

621.391 : 621.372.54 **3930**

Prediction of Signals by means of a Simple *RC* Network.—A. Schief. (*Arch. elekt. Übertragung*, Feb. 1961, Vol. 15, No. 2, pp. 91–93.) A linear *RC* filter network for the statistical prediction of signals in noise is designed and experimental results are given.

621.391 : 621.376.23 **3931**

Multiple-Burst Detection.—F. Corr. (*Proc. Inst. Radio Engrs*, Aug. 1961, Vol. 49, No. 8, p. 1337.) A class of cyclic codes exist which can correct any t bursts of maximum length b in a block of (2^b-1) b bits. A proof is given that this code can alternatively be used to detect any $2t$ bursts of length b in a similar block. bt check digits will be required.

621.396.2 **3932**

Spectrum Representation for Vestigial-Sideband Transmission in the Light of Transmission Possibilities between Single- and Double-Sideband Transmission.—N. Berger. (*Nachr. Tech.*, Jan. 1961, Vol. 11, No. 1, pp. 31–35.)

621.396.43 : 551.507.362.2 **3933**

Satellites as Passive Relay Stations for Communications over Long Distances.—W. Mansfeld. (*Frequenz*, Jan. 1961, Vol. 15, No. 1, pp.1–9.) Conditions for the use of satellites as reflectors are examined. System design features discussed include the shape and dimensions of the reflectors, transmitter output and aerial diameters.

621.396.43 : 551.507.362.2 **3934**

Participation of Bell Telephone Laboratories in Project Echo and Experimental Results.—W. C. Jakes, Jr. (*Bell Syst. tech. J.*, July 1961, Vol. 40, No. 4, pp. 975–1028.) Two-way voice communication by reflection from a 100-ft diameter spherical balloon satellite orbiting at a height of 1 000 miles was demonstrated over a coast-to-coast path in the U.S.A. Modulation tests using carrier frequencies of 960 and 2 390 Mc/s showed f.m. to be superior to other forms. Measured transmission-path loss agreed closely with theory.

621.396.43 : 551.507.362.2 **3935**

Project Echo: System Calculations.—C. L. Ruthroff & W. C. Jakes, Jr. (*Bell Syst. tech. J.*, July 1961, Vol. 40, No. 4, pp. 1029–1039.)

621.396.934 : 621.391.822 **3936**

Overall System Requirements for Low-Noise Performance.—C. R. Ditchfield. (*J. Brit. Instn Radio Engrs*, Aug. 1961, Vol. 22, No. 2, pp. 123–127.) The practical limitations of a microwave system for communication with and between satellites are discussed. The limit of performance will probably be determined by ambient noise background rather than receiver noise.

SUBSIDIARY APPARATUS

621-526 : 621.396.677 **3937**

Project Echo: Antenna Steering System.—R. Klahn, J. A. Norton & J. A. Githens. (*Bell Syst. tech. J.*, July 1961, Vol. 40, No. 4, pp. 1207–1225.) The use of basic orbital information to generate aerial steering instructions for project Echo is discussed. A digital method is described in which predicted pointing data is transmitted by teletype to the aerial site, then stored, and subsequently used when required in real time to control the aerial drive mechanism.

621-526 : 621.396.677 : 778.53 **3938**

Project Echo: Boresight Cameras.—K. L. Warthman. (*Bell Syst. tech. J.*, July 1961, Vol. 40, No. 4, pp. 1227–1233.) Cameras are attached to the project Echo transmitting and receiving antennas at Holmdel for recording the position of the satellite. An exposure of 1/30 sec at $f/3.5$ was used at 4 frames/sec.

621.3.087.4 : 621.395.625.3 **3939**

An Analytical Expression for Describing the Write Process in Magnetic Recording.—T. C. Ku. (*Proc. Inst. Radio Engrs*, Aug. 1961, Vol. 49, No. 8, pp. 1337–1338.)

621.3.087.4 : 621.397 **3940**

Video Tape Analyser.—A. A. Goldberg & M. R. Hannah. (*J. Soc. Mot. Pict. Telev. Engrs*, Feb. 1961, Vol. 70, No. 2, pp. 85–89.) Tape frequency response, noise correlation,

drop-outs and rate of wear are determined and an assessment is made of the decline in picture quality due to repeated playback.

621.311.69: 621.383.5 **3941**

Spectral Response of Solar Cells.—B. Dale & F. P. Smith. (*J. appl. Phys.*, July 1961, Vol. 32, No. 7, pp. 1377–1381.) Theoretical response curves are derived by an analysis including the effects of carrier diffusion and drift due to the electric field in the surface region.

621.311.69: 621.383.5: 551.507.362.2 **3942**

Solar Cells for Communication Satellites in the Van Allen Belts.—F. M. Smits, K. D. Smith & W. L. Brown. (*J. Brit. Instn Radio Engrs*, Aug. 1961, Vol. 22, No. 2, pp. 161–169.) The power output of solar cells on satellites is degraded by radiation damage on passing through the Van Allen belts. Methods of overcoming this are discussed.

621.311.69: 629.19 **3943**

Power Supplies for Space Vehicles.—N. W. Snyder. (*Astronautica Acta*, 1960, Vol. 6, No. 6, pp. 271–310.) A comprehensive review of types of power systems, energy sources and power converters and an examination of the problems associated with their development as power supplies for space vehicles.

621.314.63 **3944**

Commutation and Destructive Oscillation in Diode Circuits.—I. Somos. (*Commun. & Electronics*, May 1961, No. 54, pp. 162–172. Discussion.) An investigation of these phenomena in Si rectifiers and a study of how commutation may cause destruction of unprotected cells.

621.314.63 **3945**

A Fatigue-Free Silicon Device Structure.—W. B. Green. (*Commun. & Electronics*, May 1961, No. 54, pp. 186–191. Discussion.) By using hard solder instead of soft solder to make joints in the device, ruptures are no longer produced by cyclic thermal stress.

621.316.72 **3946**

Passive Voltage and Current Stabilizers using a Bridge Network.—A. Caravel. (*J. Phys. Radium*, Nov. 1960, Vol. 21, Supplement to No. 11, *Phys. appl.*, pp. 187A–190A.) The residual voltage variation, which occurs when a Zener diode is used as a stabilizer, is removed by using a Wheatstone bridge network.

621.316.721.078.3: 621.318.3 **3947**

Transistorized Current Stabilizers for Electromagnets of Medium Power (1 to 10 kW).—M. Sanoski. (*J. Phys. Radium*, Nov. 1960, Vol. 21, Supplement to No. 11, *Phys. appl.*, pp. 161A–170A.) Methods of computing the characteristics and determining the stability are given.

621.316.722.1.078 **3948**

Cathode-Coupled Cascode Stabilizer Circuits.—S. G. Jones & R. S. McClean. (*Electronic Engng*, Aug. 1961, Vol. 33, No. 402, pp. 505–507.) In a negative h.t. power supply (−6.6 kV nominal), the peak-to-peak ripple was less than 1 V and a ±10% change in line voltage gave less than 1 V change in output.

TELEVISION AND PHOTOTELEGRAPHY

621.397.12 **3949**

A High-Speed Facsimile System with Electronic Scanning.—K. Kubota, K. Kobayashi, Y. Okajima & S. Nanbo. (*Rev. elect. Commun. Lab., Japan*, March/April 1961, Vol. 9, Nos. 3/4, pp. 214–219.)

621.397.331.2 **3950**

The Problem of Signal/Noise Ratio in Television Camera Tubes.—H. Fix & A. Kaufmann. (*Radio Mentor*, Feb. 1961, Vol. 27, No. 2, pp. 114–116.) Reassessment of the relative merits of various types of camera tube with regard to signal/noise ratio. This is in closer agreement with subjective assessments and is based on measurements of the spectral composition of statistical fluctuations in camera installations (1326 of April).

621.397.331.22 **3951**

Image-Orthicon Tubes with Field Mesh.—K. Frank. (*Elektronische Rundschau*, Feb. 1961, Vol. 15, No. 2, pp. 66–68.) The picture defects which can be minimized by the use of a field mesh are summarized [see also 2926 of 1957 (Theile & Pilz)]. The disadvantages, such as moiré effects, of this system are discussed and design improvements are suggested.

621.397.331.222 **3952**

Photoconductive Camera Tubes: the C.F.T.H. Vidicons.—M. Blamoutier. (*Onde élect.*, March 1961, Vol. 41, No. 408, pp. 229–238.)

621.397.331.222 **3953**

On the Possibility of using Germanium Sulphide Photoresistors as Targets in Television Camera Tubes.—V. I. Perevedchikov & E. P. Kuznetsov. (*Radiotekhnika i Elektronika*, Sept. 1960, Vol. 5, No. 9, pp. 1470–1483.) A method of preparing high-resistivity GeS photosensitive layers is described and their main characteristics are given. The basic parameters of a vidicon-type camera tube with a GeS target are discussed.

621.397.331.24 **3954**

The Reflected-Beam Picture Tube—a Further Step towards a Flat Tube of Large Image Size.—P. Neidhardt. (*Nachr. Tech.*, Jan. 1961, Vol. 11, No. 1, pp. 27–30.) The principle of operation, design problems and practical possibilities for this type of picture tube are reviewed. See also 4003 of 1960 (Law & Ramberg).

621.397.62: 621.396.67 **3955**

The Pseudostable Mismatch in Aerial Installations for Television Reception.—A. Fiebranz. (*Nachrichtentech. Z.*, Jan. 1961, Vol. 14, No. 1, pp. 25–31.) The receiver input voltage is determined for mismatch conditions. Frequency-independent voltage components are found to depend on voltage s.w.r. only, for low-order terms. The effects of mismatch on television picture quality are discussed.

621.397.74 **3956**

The Technique of the Television Transmissions 'Session of the Federal Parliament'.—H. Probst. (*Tech. Mitt. PTT*, Feb. 1961, Vol. 39, No. 2, pp. 39–44.) Description of studio arrangements, camera equipment, mobile and fixed control installations and the transmission system used for relaying interviews from the Parliament Building in Berne.

TRANSMISSION

621.396.61: 621.396.43 **3957**

Project Echo: 960-Mc/s, 10-kW Transmitter.—J. P. Schafer & R. H. Brandt. (*Bell Syst. tech. J.*, July 1961, Vol. 40, No. 4, pp. 1041–1064.) Driver-modulator units for f.m., ph.m., s.s.b. and pulse are described. The main output amplifier consists of a four-stage water-cooled klystron.

VALVES AND THERMIONICS

621.382.2: 621.318.7: 621.317.3 **3958**

Measuring Recovery Time of Ultra-Fast Diodes.—G. C. Messenger. (*Electronic Ind.*, April 1961, Vol. 20, No. 4, pp. 99–100.) An indirect method which gives accurate results below 1 ns is described. Results have been obtained down to 0·05 ns.

621.382.22: 621.376.23.029.64 **3959**

High-Level Microwave Detector using Avalanche Injection.—H. M. Day & A. C. MacPherson. (*Proc. Inst. Radio Engrs*, Aug. 1961, Vol. 49, No. 8, pp. 1333–1334.) An avalanche injection microwave diode has been constructed which has useful properties as a large-signal detector. At 9·350 Mc/s, rectified voltages up to 12 V across 200 Ω have been obtained with input power varying from 1 to 3 W.

621.382.23 **3960**

A Method for Determining the Base Voltage and Contact Resistance of a Conductivity-Modulated Diode.—J. M. Swartz & H. C. Gorton. (*Proc. Inst. Radio Engrs*, Aug. 1961, Vol. 49, No. 8, pp. 1326–1327.) The contact resistance is measured from the dynamic change in voltage with current at high levels of carrier injection.

621.382.23: 539.12.04 **3961**

Electron-Bombardment Damage in Silicon Esaki Diodes.—R. A. Logan, W. M. Augustyniak & J. F. Gibbons. (*J. appl. Phys.*, July 1961, Vol. 32, No. 7, pp. 1203–1205.) The excess current in Si Esaki diodes has been shown to be a sensitive indicator of the density and distribution of states introduced into the forbidden gap by electron bombardment. The effects of bombardment and the annealing properties of the radiation damage depend on the specific donor in the n-type region.

621.382.23: 621.372.44 **3962**

Large-Signal Circuit Theory for Negative-Resistance Diodes, in particular Tunnel Diodes.—M. Schuller & W. W. Gärtner. (*Proc. Inst. Radio Engrs*, Aug. 1961, Vol. 49, No. 8, pp. 1268–1278.) The device and its external circuit are characterized by a system of accurate non-linear differential equations and solutions are obtained by an electronic computer. Results agree with measurements.

621.382.23: 621.373.431.1 **3963**

The Tunnel-Diode Pair.—Hamilton & Morgan. (See 3677.)

621.382.3: 621.317.3 **3964**

Measurement of Transistor Quadripole Parameters.—R. Paul. (*Nachr Tech.*, Jan. 1961, Vol. 11, No. 1, pp. 8–12.) Measuring circuits are given and the accuracy of measurement is estimated. See also *ibid.*, Feb. 1960, Vol. 10, No. 2, pp. 56–61.)

621.382.3: 621.317.7 **3965**

Transistor Current Gain at U.H.F.—B. N. Harden. (*Electronic Technol.*, Sept. 1961, Vol. 38, No. 9, pp. 312–316.) "A coaxial-line system and a twin-channel comparator are used to determine amplitude and phase variations of current gain. Results in the frequency range 300–800 Mc/s are compared with values obtained by a bridge method." See 3426 of 1959 (Smith & Hyde).

621.382.3: 621.391.822 **3966**

Investigation of the Noise of Semiconductors.—I. P. Valkó. (*Period. polyt. Bp., Elect. Engng*, 1961, Vol. 5, No. 1, pp. 57–73. In German.) Results of investigations of low-frequency transistor noise are reviewed. Details are given of test equipment for the direct indication of noise amplitude and spectral distribution.

621.382.32 **3967**

Graphical Analysis of the Operation of the Tecnetron: Parts 1 & 2.—A. V. J. Martin & J. Le Mée. (*J. Phys. Radium*, Feb. & June 1961, Vol. 22, Supplements to Nos. 2 & 6, *Phys. appl.*, pp. 1A–12A & 83A–90A.) The operation of the device in the sub-critical field region, where the carrier mobility is considered to be constant, is analysed graphically and a set of universal curves of the main characteristics is derived. A detailed comparison is made between analytical and graphical approximations. See also *Convention Record Inst. Radio Engrs*, 1959, Vol. 7, Part 3, pp. 9–17, and 1341 of 1961 (Martin).

621.382.333 **3968**

Characteristic Transistor Properties for Communications Applications and their Interrelation.—W. Benz. (*Frequenz*, Jan. 1961, Vol. 15, No. 1, pp. 17–29.) Detailed consideration of the operation of a transistor as an amplifier including a discussion of d.c. conditions and dependence on temperature, frequency and working point. Transistor noise and nonlinear distortion, and the application of the transistor as a switching device are also mentioned. 52 references.

621.382.333 **3969**

A Method of Determining the Impurity-Doping Profile of a Transistor from Measurements of Certain of its Electrical Characteristics.—J. P. Bict. (*J. Phys. Radium*, Feb. 1961, Vol. 22, Supplement to No. 3, *Phys. appl.*, pp. 59A–63A.) By measuring the hybrid-π parameters as a function of collector voltage and current, values can be obtained for the resistivity of the base and of the collector region, and the shape of the junctions and base width can be ascertained.

621.382.333.33: 621.372.632 **3970**

On Parametric Amplification in Transistors.—J. Lindmayer & C. Wrigley: V. W. Vodicka & R. Zuleeg. (*Proc. Inst. Radio Engrs*, Aug. 1961, Vol. 49, No. 8, pp. 1335–1337.) Comment on 4420 of 1960 and 369 of January, and authors' reply.

621.382.333.34 **3971**

***p-n-p-n* Structures and a Solid-State Silicon Thyratron.**—M. Sassier. (*Onde élect.*, March 1961, Vol. 41, No. 408, pp. 239–246.) The theoretical relations governing the operation of *p-n-p-n* triodes are considered and applied to an analysis of the characteristics of a Si thyratron. Methods of manufacture are outlined.

621.383: 535.376 **3972**

Infrared Detectors based on Phosphors.—R. Groth. (*Z. Naturf.*, Feb. 1961, Vol. 16a, No. 2, pp. 169–172.) The principle of a detector using infrared-sensitive phosphors is described and experimental results are given which were obtained with a SrS-Ce-Sm phosphor. A sensitivity of 6×10^{-11} W was achieved near $\lambda = 1\ \mu$.

621.383.49 **3973**

Reduction of Optical Reflection by Blooming without Increasing the Surface Recombination in Germanium Photoresistors.—F. R. Kessler. (*Z. angew. Phys.*, Feb. 1961, Vol. 13, No. 2, pp. 72–74.) Comparison of results obtained with vapour-deposited $PbCl_2$ and Se; in the latter case the surface recombination remains unchanged but the sensitivity of the photoresistor is considerably increased.

621.383.51 **3974**

Germanium Bicrystals and their Application in Grain-Boundary Photocells.—H. F. Mataré. (*Elektronische Rundschau*, Feb. & May 1961, Vol. 15, Nos. 2 & 5, pp. 57–60 & 207–211.) The mechanical and chemical structure of the grain boundary is considered and a model derived. The effect of impurities and the electrical properties of the bicrystal interface are discussed. Practical applications of this type of cell are mentioned. 27 references.

621.383.8 **3975**

Large-Field Image-Intensifier Tubes for Visual, Ultraviolet and Infrared Ranges.—L. F. Guyot. (*Onde élect.*, March 1961, Vol. 41, No. 408, pp. 220–228.) A series of four tubes with 100-mm object field and luminance gain up to 6 000 is described.

621.385.032.213.23 **3976**

Measurement of Oxide-Cathode Evaporation in Thermionic Valves with Radioactive Isotopes.—C. Röszler. (*Nachr Tech.*, Jan. 1961, Vol. 11, No. 1, pp. 13–16.) Results of experimental investigations on various types of valve are summarized.

621.385.032.213.23 **3977**

Suppression of Emission from Portions of Barium-Activated Tungsten Dispenser Cathodes and Adjoining Electrodes.—R. Levi & E. S. Rittner. (*Proc. Inst. Radio Engrs*, Aug. 1961, Vol. 49, No. 8, pp. 1323–1324.) A technique for carburizing portions of a Ba-activated cathode to suppress the electron emission from areas where it is undesirable. Reductions in emission of two orders of magnitude are possible.

621.385.032.269.1 **3978**

The Matching of Pierce Guns to Tunnels.—C. J. Milner & K. J. Ausburn. (*Brit. J. appl. Phys.*, July 1961, Vol. 12, No. 7, pp. 346–347.) All Pierce guns which shoot the maximum electron current through two identical apertures collinear with the axis of the gun have a unique ratio of cathode to anode radius. The value of this unique ratio is given for four important cases. A simple design procedure and relevant numerical data are given.

621.385.3 + 621.385.5 **3979**

A Method of Stabilizing the Gain of Triodes and Pentodes.—H. Lorenz. (*Nachr Tech.*, Dec. 1960, Vol. 10, No. 12, pp. 534–536.) The stabilization is effected by using a cathode resistance appropriate to the working point of the valve. The resistance value is determined by measurement.

621.385.6 **3980**

Three Interpretations of Space-Charge Waves in Electron Beams.—H. Groendijk. (*Tijdschr. ned. Radiogenoot.*, 31st July 1961, Vol. 26, No. 2, pp. 51–64.) The phenomenon is interpreted as (*a*) a single moving wave with phase velocity equal to the beam velocity and amplitude varying sinusoidally with position, (*b*) two moving waves of constant amplitude with different phase velocities, and (*c*) a stream of independent oscillators.

621.385.6: 537.533 **3981**

Propagation in Periodic Electron Beams.—W. M. Mueller. (*J. appl. Phys.*, July 1961, Vol. 32, No. 7, pp. 1349–1360.) A small-signal analysis of smooth electron beams with periodic variations in their d.c. parameters reveals the existence of infinite sets of space harmonics of the fast and slow space-charge waves. Various effects and the possible uses of the periodicity in beams are mentioned.

621.385.6: 621.372.8 **3982**

Electromagnetic Radiation from a Beam of Charged Particles Passing near a Waveguide with an Infinite Flange.—Yu. N. Dnestrovskiĭ & D. P. Kostomarov. (*Radiotekhnika i Elektronika*, Sept. 1960, Vol. 5, No. 9, pp. 1431–1441.) A two-dimensional analysis of the e.m. radiation from a modulated electron beam passing the flange of a planar waveguide. The problem is reduced to a set of algebraic solutions which are solved analytically for a range of electron velocities.

Abstracts and References

COMPILED BY THE RADIO RESEARCH ORGANIZATION OF THE DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH AND PUBLISHED BY ARRANGEMENT WITH THAT DEPARTMENT

The abstracts are classified in accordance with the Universal Decimal Classification. They are arranged within broad subject sections in the order of the U.D.C. numbers, except that notices of book reviews are placed at the ends of the sections. U.D.C. numbers marked with a dagger (†) must be regarded as provisional. The abbreviations of journal titles conform generally with the style of the World List of Scientific Periodicals. An Author and Subject Index to the abstracts is published annually; it includes a list of journals abstracted, the abbreviations of their titles and their publishers' addresses. Copies of articles in journals referred to are not available from Electronic Technology. *Application must be made to the individual publishers concerned.*

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Miscellaneous A208

ACOUSTICS AND AUDIO FREQUENCIES

534.2 **3983**

Solution of an Integral Equation Occurring in the Study of Certain Wave-Propagation Problems in Layered Media.—I. M. Longman. (*J. acoust. Soc. Amer.*, July 1961, Vol. 33, No. 7, pp. 954–958.) A method of inversion of an integral equation arising in the solution of the problem of reflection or refraction of a spherical sound-wave pulse at a plane interface in a layered elastic medium.

534.231 **3984**

The Computation of Far-Field Radiation Patterns from Measurements made Near the Source.—C. W. Horton & G. S. Innis, Jr. (*J. acoust. Soc. Amer.*, July 1961, Vol. 33, No. 7, pp. 877–880.) Two methods based on (*a*) the use of Green's functions, and (*b*) a proposal made by Pachner (1933 of 1956) are analysed and compared.

534.232 **3985**

Sound Radiation from Prolate Spheroids.—G. Chertock. (*J. acoust. Soc. Amer.*, July 1961, Vol. 33, No. 7, pp. 871–876.) An analysis of the radiation from a spheroid providing expressions for pressure and velocity distributions, radiation impedance and directivity factor in each mode.

534.232-8: 538.652 **3986**

Ultrasonic Transducer Design cuts Losses.—H. L. Morgan. (*Electronics*, 18th Aug. 1961, Vol. 34, No. 33, pp. 70–73.) Magnetostrictive tape and insulating material are wound into a cylinder. Possible methods of cooling high-power transducers are discussed.

534.24-14 **3987**

Theoretical and Experimental Study of Underwater Sound Reverberation.—B. F. Cron & W. R. Schumacher. (*J. acoust. Soc. Amer.*, July 1961, Vol. 33, No. 7, pp. 881–888.) Fluctuations of amplitude and phase associated with the return of a single-frequency pulse were studied. By using the correct filter, a considerable gain in signal quality could be achieved.

534.522.1 **3988**

Diffraction of Light by Ultrasonic Waves of Various Standing-Wave Ratios.—B. D. Cook & E. A. Hiedemann. (*J. acoust. Soc. Amer.*, July 1961, Vol. 33, No. 7, pp. 945–948.)

534.79 **3989**

Investigation for the Complete Representation of the Laws of Loudness Growth with any Complex Form of Noise Excitation.—H. Niese. (*Hochfrequenztech. u. Elektroakust.*, Feb. 1961, Vol. 70, No. 1, pp. 5–17.) Extension of investigations of the inertia effect in hearing on the basis of earlier experimental results (e.g. 11 of January).

534.844.1 **3990**

The Influence of the Diffusing Area and the Dimensions of a Reverberation Chamber on the Measured Coefficient of Sound Absorption.—U. Kath & W. Kuhl. (*Acustica*, 1961, Vol. 11, No. 1, pp. 50–64. In German.)

534.88: 621.396.677 **3991**

Improved Directivity using Synchronous Demodulation.—D. G. Tucker. (*Acustica*, 1961, Vol. 11, No. 1, pp. 45–49.) In a limited application greatly improved directional response can be obtained by the use of synchronous demodulation in conjunction with a receiving array whose secondary responses are in reverse phase relative to the main beam. Compared with a multiplicative system, response suppression is better but the narrowing of the main lobe is not so great.

534.88: 621.396.677.3 **3992**

Array Steering in a Layered Waveguide.—C. S. Clay. (*J. acoust. Soc. Amer.*, July 1961, Vol. 33, No. 7, pp. 865–870.) Time-delay steering of the array will give several maxima and minima but a mechanically steered array will give one well-defined maximum.

621.395.625.3 **3993**

Mechano-electrical Analogues for the Filtering of Electroacoustic Drive Systems.—W. Wolf. (*Tech. Mitt. BRF, Berlin*, March & June 1961, Vol. 5, Nos. 1 & 2, pp. 1–9 & 49–58.) The problem of overcoming fluctuations in mechanical tape transport mechanisms is investigated with the aid of electromechanical analogues and measurements on equivalent electrical circuits. See also 1400 of May.

AERIALS AND TRANSMISSION LINES

of systems of equations giving the propagation constant of gyromagnetic waveguides. See 707 of 1959 (Hauser).

621.315.212 **3994**

Theory and Design of a Coaxial Supporting Bead made of Composite Dielectrics.—G. F. Owyang. (*Canad. J. Phys.*, June 1961, Vol. 39, No. 6, pp. 926–934.) A formula correlating the standing-wave ratio with parameters of the bead is derived. An example shows that ratios $< 1{\cdot}003$ are possible over a frequency range of 13:1.

621.372.2: 621.372.414 **3995**

Contribution to the Problem of the Homogeneous Lecher Line with Non-linear Capacitive Loading.—G. Böhme. (*Hochfrequenztech. u. Elektroakust.*, Feb. 1961, Vol. 70, No. 1, pp. 25–30.) An approximate solution of the line equations is derived by means of an iterative method. The application of the system to parametric amplification is considered.

621.372.21.018.78 **3996**

A New Method of Calculating Signal Distortion in High-Frequency Cables.—K. Rihaczek & H. Worner. (*Nachrichtentech. Z.*, March 1961, Vol. 14, No. 3, pp. 119–124.) The transmission factor is evaluated in the form of a power series or, in approximation, by polynomials. Examples are given of calculations of optimum carrier frequency for low signal distortion in pulse transmission systems.

621.372.8: 537.226 **3997**

Cylindrical Dielectric Waveguide Modes.—E. Snitzer. (*J. opt. Soc. Amer.*, May 1961, Vol. 51, No. 5, pp. 491–498.) Sets of solutions are derived for both hybrid modes, giving cut-off, field distribution and conditions far from cut-off. Field plots for the lower-order modes are shown.

621.372.82: 536.48 **3998**

Simple Approach to Cryogenic Waveguide.—D. K. Milne. (*J. sci. Instrum.*, Aug. 1961, Vol. 38, No. 8, p. 335.) The advantages of using a 'quasi-elliptical' guide are discussed.

621.372.823 **3999**

On the Nomenclature of TE_{n_0} Modes in a Cylindrical Waveguide.—C. T. Tai. (*Proc. Inst. Radio Engrs*, Sept. 1961, Vol. 49, No. 9, pp. 1442–1443.) A modification of notation produces a more logical nomenclature for all the modes in a cylindrical waveguide. The number of propagation modes for a given waveguide may be determined from the graph presented.

621.372.85 **4000**

Variational Principle relating to Systems of Equations with Common Eigenvalues. Application to the Calculation of the Propagation Constant of Electromagnetic Waves in Guides with Anisotropic Media.—L. Cairó & T. Kahan. (*C. R. Acad. Sci., Paris*, 31st Oct. 1960, Vol. 251, No. 18, pp. 1865–1867.) A variational principle of general character is established and is applied to the case

621.372.851.2 **4001**

The Construction of Narrow-Band Microwave Diaphragm Filters in Waveguide.—J. Windel. (*Nachr Tech.*, March 1961, Vol. 11, No. 3, pp. 115–121.) Details of the design and performance of inductive irises are given.

621.396.67 **4002**

Aerials.—H. Page. (*Proc. Instn elect. Engrs*, Part B, Sept. 1961, Vol. 108, No. 41, pp. 473–489.) A review of progress. 74 references.

621.396.67 **4003**

Theoretical Techniques for Handling Partially Polarized Radio Waves with Special Reference to Antennas.—H. C. Ko. (*Proc. Inst. Radio Engrs*, Sept. 1961, Vol. 49, No. 9, pp. 1446–1447.) The power available from the aerial can be expressed in terms of the Stokes parameters or the density matrix.

621.396.67 **4004**

Experimental Investigations on the Applicability of the Principle of Superposition in the Design of Combinations of Aerials.—E. Hüttmann. (*Nachr Tech.*, Feb. 1961, Vol. 11, No. 2, pp. 93–96.) Consideration of the distribution of displacement currents to obtain a more precise picture of the radiation mechanism of combined aerials, with particular reference to a special type of V-aerial.

621.396.67 **4005**

Attenuation Effect of a Tiled Roof in the Case of Loft Aerials.—H. Hugli. (*Tech. Mitt. PTT*, April 1961, Vol. 39, No. 4, pp. 152–154. In German and French.) Brief note on the measurements to be carried out to determine the attenuation. Results are given of measurements made with different aerials in the range 50–950 Mc/s under a dry and a wet roof.

621.396.67(083.7) **4006**

Categories and Types of Aerials.—(*Nachrichtentech. Z.*, Feb. 1961, Vol. 14, No. 2, pp. 92–96.) Glossary of 75 proposed terms and definitions with, in some cases, English and French equivalent terms.

621.396.676: 551.510.535 **4007**

The Electrically Short Antenna as a Probe for Measuring Free Electron Densities and Collision Frequencies in an Ionized Region.—King, Harrison & Denton. (See 4134.)

621.396.677: 534.88 **4008**

Improved Directivity using Synchronous Demodulation.—Tucker. (See 3991.)

621.396.677: 621.396.43 **4009**

Antenna-Beam Configurations in Scatter Communications.—A. T. Waterman, Jr. (*Proc. Inst. Radio Engrs*, Sept. 1961, Vol. 49, No. 9, p. 1452.) There is a difference in the directivities of the scattering process which operate in tropospheric scattering and in incoherent scattering by free electrons. The consequences are discussed in terms of the desirable polar diagrams of aerial systems used in scatter communications.

621.396.677.3 **4010**

Super-Gain Aerials.—T. Heller. (*Nachrichtentech. Z.*, March 1961, Vol. 14, No. 3, pp. 113–118.) The principle of super-directive aerial arrays is discussed and the design is given of three end-fire and side-fire arrays with 15, 21 and 31 radiators and spacings of $0{\cdot}43\,\lambda$, $0{\cdot}3\,\lambda$ and $0{\cdot}2\,\lambda$ respectively.

621.396.677.3: 534.88 **4011**

Array Steering in a Layered Waveguide.—Clay. (See 3992.)

621.396.677.7 **4012**

Omnidirectional K-Band Antenna uses Slots, Probes and Horns.—G. J. Monser & E. D. Botkin. (*Electronics*, 18th Aug. 1961, Vol. 34, No. 33, pp. 54–55.) The nominal vertical beamwidth is 30° centred on the horizon. The frequency range covered is 1·5 to 1 with a voltage s.w.r. less than 3:1.

621.396.677.83 **4013**

Gain Limit and Tolerances of Big Reflector Antennas.—A. Consortini, L. Ronchi, A. M. Scheggi & G. Toraldo di Francia. (*Alta Frequenza*, March 1961, Vol. 30, No. 3, pp. 232–243. In English.) The effects of manufacturing errors on aerial gain are studied for the parabolic aerial. Assuming that the construction tolerances are greater for larger aerials, an optimum size of aerial is found for the expected maximum gain.

AUTOMATIC COMPUTERS

681.142 **4014**

High-Speed Analogue-Digital Converter.—Y. Hanon. (*C. R. Acad. Sci., Paris*, 18th July 1960, Vol. 251, No. 3, pp. 343–345.) Details are given of a fully transistorized unit for the conversion of pulse-amplitude data to numbers of pulses. Use is made of a tunnel-diode/transistor combination in the blocking oscillator circuit to produce oscillations at a frequency of (a) 10 Mc/s or (b) 40 Mc/s. The overall dead time of the converter is reduced by 10 times.

681.142: 535.215 **4015**

Optical Erasure of ZnS-PC and Non-PC Storage Elements.—J. A. O'Connell & R. Nathan. (*Proc. Inst. Radio Engrs*, Sept. 1961, Vol. 49, No. 9, pp. 1438–1439.) A new method of selective storage and erasure using 'optrons' is described. A single light source of constant intensity with emission within the sensitivity range of the photoconductor will latch optrons with short pulses (< 30 ns) and erase them with long pulses (> 200 ns).

681.142: 537.227 **4016**

Obtaining Synchronous Read-Out with Piezoelectric Memories.—A. E. Kaufman. (*Electronics*, 25th Aug. 1961, Vol.

34, No. 34, pp. 47–51.) The development and initial tests of a monomorphic, polycrystalline Ba titanate storage cell used as a three- or four-terminal device.

681.142: 538.221 **4017**

The Magnetic Flux Counter.—G. Müller. (*Nachrichtentech. Z.*, Feb. 1961, Vol. 14, No. 2, pp. 81–87.) The principle and application of multistable magnetic storage systems are discussed.

681.142: 538.632: 621.375.432 **4018**

Feedback Amplification Improves Hall-Effect Multipliers.—R. A. Greiner. (*Electronics*, 25th Aug. 1961, Vol. 34, No. 34, pp. 52–55.) A transistor feedback amplifier supplies a field coil current in phase with the input signal. A d.c. component is added to increase the common-mode signal rejection.

681.142: 621.318.134 **4019**

A 0·7-Microsecond Ferrite Core Memory.—W. H. Rhodes, L. A. Russell, F. E. Sakalay & R. M. Whalen. (*IBM J. Res. Develpm.*, July 1961, Vol. 5, No. 3, pp. 174–182.) A storage capacity of 71 728 bits is achieved with an instruction repetition rate of 1·67 Mc/s.

CIRCUITS AND CIRCUIT ELEMENTS

621.3.064: 621.372.44 **4020**

Switching Processes in D.C. Circuits with Nonlinear Resistance and Nonlinear Inductance.—W. Boning. (*Arch. Elektronik.*, 15th March 1961, Vol. 46, No. 3, pp. 103–128.) Normalized differential equations are derived for the analysis of switching processes involving nonlinear resistance with semiconductor- or valve-type characteristics.

621.314.2.029.53–62: 621.314.632.4 **4021**

Design of Wide-Band Shielded Toroidal R.F. Transformers.—R. S. Irey & B. Howland. (*Rec. ni. Instrum.*, July 1961, Vol. 32, No. 7, pp. 964–965.) Details of transformers for use with single- or bifilar junctions in the frequency range 1–100 Mc/s.

621.314.22: 621.378 **4022**

Determination of Core Size in Pulse Transformer Design.—C. F. Wells. (*Electron. Engng*, Sept. 1961, Vol. 33, No. 403, pp. 568–573.) The construction of a design chart is described and its application is illustrated.

621.318.57: 530.223 **4023**

Transfer of Square-Loop Ferrite Material on Switching Elements.—W. Hilberg. (*Arch. elekt. Übertragung*, March 1961, Vol. 15, No. 3, pp. 145–152.) A differential equation is derived which describes magnetic reversal processes in square-loop ferrites neglecting the effect of eddy currents. The application of this analysis to practical switching circuits is considered.

621.318.57: 621.382.23: 621.374 **4024**

Tunnel Diodes increase Digital-Circuit Switching-Speeds.—W. V. Harrison & R. S. Foote. (*Electronics*, 11th Aug. 1961, Vol. 34, No. 32, pp. 154–156.) GaAs tunnel diodes are used with transistors in high-speed switching circuits suitable for pulse-generator operation.

621.318.57: 681.142 **4025**

Application of Karnaugh's Mirror Symbols to Transfluxors.—F. Schreiber. (*Frequenz*, Feb. 1961, Vol. 15, No. 2, pp. 58–61.) A transfluxor symbol is proposed which is based on the system used by Karnaugh (2207 of 1955) for magnetic-core switching circuits.

621.372.413: 621.385.644.3 **4026**

An Analysis of a Cylindrical Cavity with Radial Vanes.—A. Singh & R. A. Rao. (*Proc. Instn elect. Engrs*, Part B, Sept. 1961, Vol. 108, No. 41, pp. 550–555.) The procedure involves the use of variational methods for obtaining successively better approximations to the resonance frequencies and the field configuration.

621.372.414: 621.372.8 **4027**

An Analysis of the Travelling-Wave Cavity.—N. Karayianis & C. A. Morrison. (*Proc. Instn elect. Engrs*, Part B, Sept. 1961, Vol. 108, No. 41, pp. 545–549.) The measured response of a travelling-wave cavity differs from that predicted by simple theory. An internal mismatch can explain the observed response.

621.372.52 **4028**

Rules for the Verification of the Stability of Normal Linear Negative-Feedback Systems.—A. Lepschy & A. Roberti. (*Alta Frequenza*, April 1961, Vol. 30, No. 4, pp. 285–296.) The stability criterion and rules are formulated and the procedure of applying the rules to pole diagrams and curves of the system function is described.

621.372.54 **4029**

A Filter System with Favourable Pulse Characteristics.—K. Uhl. (*Arch. elekt. Übertragung*, March 1961, Vol. 15, No. 3, pp. 109–114.) Analysis of filter performance under pulse conditions on the basis of the distribution of poles and zeros of the transfer function. A practical filter circuit is derived and the pulse amplitudes calculated.

621.372.54: 534.1 **4030**

Mechanical Filters with Flexural Coupling.—M. Barzen. (*Arch. elekt. Übertragung*, April 1961, Vol. 15, No. 4, pp. 175–188.) The use of flexural coupling between longitudinal resonators makes possible the construction of very small mechanical filters for operation around 100 kc/s. The characteristics of such a system are calculated, and two practical examples are given. See also 2155 of 1958 (Barzen et al.).

621.372.542.2 **4031**

The Design of Filters with the Aid of the Catalogue of Normalized Low-Pass Filters.—R. Saal. (*Frequenz*, April 1961, Vol. 15, No. 4, pp. 113–123.) Filter design by the insertion-loss method is facilitated by the use of tables prepared with the aid of an electronic computer [see 2051 of 1957 (Glowatzki)]. The design of Tchebycheff-type and Cauer-parameter low-pass filters is considered in detail.

621.372.543 **4032**

Diagrams for the Design of Double-Tuned Band Filters with Arbitrary Coupling.—Sittner & Minner. (*Frequenz*, March 1961, Vol. 15, No. 3, pp. 93–99.) The design curves and equations given are based on filter parameters which can be obtained directly by measurement in the filter circuit.

621.372.543.2: 534.143 **4033**

Insertion Loss of Electromechanical Coupling Filters.—E. Trzeba. (*Hochfrequenztech. u. Elektroakust.*, Feb. 1961, Vol. 70, No. 1, pp. 17–20.) The insertion loss is defined and design formulae are derived for minimizing this loss. See also 2497 of August.

621.372.543.2: 534.143 **4034**

Experiences with Mechanical Band Filters.—H. J. Rohde. (*Hochfrequenztech. u. Elektroakust.*, Feb. 1961, Vol. 70, No. 1, pp. 31–38.) Problems arising in the construction of electromechanical filters are discussed and some practical types of filter are described.

621.372.543.22 **4035**

A Crystal Filter of Increased Bandwidth and its Synthesis.—W. Herzog. (*Nachrichtentech. Z.*, March 1961, Vol. 14, No. 3, pp. 113–117.) The method given in 1750 of June is applied to a lattice-type filter with a crystal in each bridge arm.

621.372.55: 621.397.6 **4036**

A Differentiating Equalizer with Transistors.—H. Andres & U. Rosse. (*Rundfunktech. Mitt.*, April 1961, Vol. 5, No. 2, pp. 66–75.) The equipment described is designed for emphasizing the upper frequencies of the ...-kc signal band without phase distortion.

621.372.6 **4037**

A Synthesis Procedure for an n-Port Network.—D. Hazony & H. J. Nass. (*Proc. Inst. Radio Engrs*, Sept. 1961, Vol. 49, No. 9, pp. 1431–1432.) The method is based on the Bott-Duffin procedure for two-port networks.

621.373: 621.372.44: 621.392.29 **4038**

Stable Systems of Differential Equations with Applications to Tunnel-Diode Circuits.—J. K. Moore. (*IBM J. Res. Develpm.*, July 1961, Vol. 5, No. 3, pp. 226–240.) A mathematical theory is developed for nonlinear circuits with at least two stable steady states. The theory is applied in detail to circuits containing one or two tunnel diodes.

621.375.42 **4039**

New Wide-Range Oscillator Technique.—L. M. Sargent. (*Rec. Commun. Electronics*, Aug. 1961, Vol. 4, No. 8, pp. 600–603.) A modification of the Wien bridge RC oscillator circuit is used in an instrument with a range of 10 c/s–10 Mc/s.

621.373.422:621.382.23 **4040**

Crystal-Stabilized Tunnel-Diode Oscillators.—J. J. Nagle. (*Electronics*, 1st Sept. 1961, Vol. 34, No. 35, pp. 40–42.) Theory and design procedure is given for a 40-Mc/s oscillator with frequency stability of 7 × 10⁻⁶ parts per million per °C.

621.373.43:621.382.23 **4041**

One-Tunnel-Diode Binary.—A. J. Whetmore & S. Yoonoos; R. A. Kennel. (*Proc. Inst. Radio Engrs*, Sept. 1961, Vol. 49, No. 9, p. 1445.) Comment on 1761 of June and author's reply.

621.373.52 **4042**

An Analysis of the Modes of Operation of a Simple Transistor Oscillator.—J. F. Gibbons. (*Proc. Inst. Radio Engrs*, Sept. 1961, Vol. 49, No. 9, pp. 1303–1390.) An analysis predicting two modes of oscillation: a two-terminal transit-time mode and a three-terminal mode.

621.374:621.382.3 **4043**

Transistor Precision Pulse Shaper with Short Recovery Time.—A. De Lotto. (*Alta Frequenza*, March 1961, Vol. 30, No. 3, pp. 219–223. In English.) The circuit is designed to minimize the effects of temperature changes and individual variations in transistors. The pulse duration varied by < 1% for a temperature range of 25–45 °C and by < 2% in ten similar circuits.

621.374.3 **4044**

A Neuristor Prototype.—A. J. Cote, Jr. (*Proc. Inst. Radio Engrs*, Sept. 1961, Vol. 49, No. 9, pp. 1430–1431.) A description of an electronic lumped-element model of the neuristor proposed by Crane (*Trans. Inst. Radio Engrs*, Sept. 1960, Vol. EC-9, No. 3, pp. 370–371).

621.374.3:621.382.233 **4045**

Some Circuit Applications of Avalanche Devices.—G. M. Ettinger. (*Proc. Instn elect. Engrs*, Part B, Sept. 1961, Vol. 108, No. 41, pp. 565–569.) Applications of *p–n–p–n* avalanche diodes in analogue computers, process control, oscillography and telemetry are discussed.

621.374.32 **4046**

Study of a Diode Bridge Nanosecond Resolution Coincidence Circuit.—S. C. Pancholi & N. K. Saha. (*Proc. nat. Inst. Sci. India, A*, 26th March 1961, Vol. 27, No. 2, pp. 155–160.) A highly stable circuit is described which can provide a resolution down to 0·7 ns.

621.374.44 **4047**

Frequency Components in the Output of a Harmonic Generator driven by the Sum of Two Sine Waves.—G. Einarsson. (*Ericsson Tech.*, 1961, Vol. 17, No. 1, pp. 139–148.) A frequency analysis is given for the output of a generator which emits a constant-amplitude pulse at each zero crossing of the input voltage consisting of the sum of two sine waves raised to an arbitrary d.c. level.

621.374.44 **4048**

A Random Pulse Generator with Variable Mean Rate.—J. L. Douce & B. G. Leary. (*Proc. Instn elect. Engrs*, Part B, Sept. 1961, Vol. 108, No. 41, pp. 524–528.) Method of producing a random-pulse train with predetermined statistical properties.

621.375.018.756:621.317.7 **4049**

Amplifier for the Generation of Accurately Controlled Microsecond Pulses.—J. B. Gunn. (*Rev. sci. Instrum.*, July 1961, Vol. 32, No. 7, pp. 804–807.) A description is given of a pulse amplifier whose output voltage can be accurately controlled by the setting of a ten-turn potentiometer. The output amplitude and pulse lengths are variable up to 1 000 V, 2·6 A, and 10 μs, respectively.

621.375.024:623.454-519 **4050**

Designing Hybrid D.C. Amplifiers to Withstand Missile Environments.—R. L. Konigsberg. (*Electronics*, 11th Aug. 1961, Vol. 34, No. 32, pp. 157–159.) The amplifier comprises one valve and 36 transistors, and is based on the Goldberg principle for d.c. drift correction.

621.375.1:621.391.822 **4051**

Actual Noise Measure of Linear Amplifiers.—K. Kurokawa. (*Proc. Inst. Radio Engrs*, Sept. 1961, Vol. 49, No. 9, pp. 1391–1397.) A new noise measure is proposed which includes the noise contribution from the load. It is of particular use in comparing amplifiers whose terminations are not necessarily optimized.

621.375.233 **4052**

Automatic Gain Control for Superregenerative Amplifiers.—J. H. Koch. (*Electronics*, 21st July 1961, Vol. 34, No. 29, pp. 76–79.) The circuit given stable operation for long periods and maintains output pulses constant over a 90-dB range of input signals.

621.375.9:538.569.4 **4053**

'Quadratic' Behaviour in a Low-Frequency Beam-Type Maser.—T. Shimizu & K. Shimoda. (*J. phys. Soc. Japan*, April 1961, Vol. 16, No. 4, pp.777–791.) Characteristics are discussed theoretically when the adiabatic focusing approximation can no longer be assumed.

621.375.9:538.569.4 **4054**

A Travelling-Wave Maser using Chromium-Doped Rutile.—E. S. Sabisky & H. J. Gerritsen. (*Proc. Inst. Radio Engrs*, Aug. 1961, Vol. 49, No. 8, pp. 1329–1330.) The active material is of small cross-section and is connected to standard-size X-band waveguides by dielectric tapers. Performance figures quoted show appreciable gain per unit length with a very large tunable bandwidth obtained without the use of any external slowing structure.

621.375.9:538.569.4:538.222 **4055**

Maser Action in Emerald.—F. E. Goodwin. (*J. appl. Phys.*, Aug. 1961, Vol. 32, No. 8, pp. 1624–1625.) The successful operation of a single-cavity reflection-type maser amplifier at 10 Gc/s using synthetic emerald is reported.

621.375.9:538.569.4:538.222 **4056**

Maser Action in Ruby by Off-Resonance Pumping.—F. Arams & M. Birnbaum. (*Proc. Inst. Radio Engrs*, Sept. 1961, Vol. 49, No. 9, pp. 1426–1427.) Population inversion probe have been observed using a pump frequency as much as 1 400 Mc/s from the centre frequency. The experimental results are discussed and explained.

621.375.9:538.569.4:621.396.65 **4057**
:551.507.362.2

The Maser and its Application to Satellite Communication Systems.—F. Hlawiczka. (*J. Brit. Instn Radio Engrs*, Sept. 1961, Vol. 22, No. 3, pp. 265–270.) The properties of the travelling-wave maser with a comb structure are discussed with particular reference to the 2–10 Gc/s frequency range. Performance is estimated and compared with a parametric amplifier in a practical aerial system.

621.375.9:621.372.44 **4058**

A Tunable Resonance-Type Straight Amplifier for the U.H.F. Range.—L. Bernhardt. (*Arch. elekt. Übertragung*, March 1961, Vol. 15, No. 3, pp. 153–160.) An experimental variable-capacitance amplifier tunable in the range 680–730 Mc/s, with a pump frequency of 1 900 Mc/s, is described. With a 10-Mc/s bandwidth the noise figure is better than that obtainable with a conventional earthed-grid triode amplifier. See also 93 of January (Maurer *et al.*).

621.375.9:621.372.44:621.372.2 **4059**

Gain Saturation in a Travelling-Wave Parametric Amplifier.—A. Jaskes & F. N. Rollans. (*Proc. Inst. Radio Engrs*, Sept. 1961, Vol. 49, No. 9, pp. 1433–1434.) There is a periodic transfer of power along the line, between signal, idler and pump frequencies (see 1827 of 1960). The nonlinear reduction in gain with increase of signal strength is shown graphically.

621.375.9:621.372.44:621.382.3 **4060**

Parametric Amplification with Transistors.—C. L. Rohde. (*Wireless World*, Oct. 1961, Vol. 67, No. 10, pp. 490–499.) A note on the operation and characteristics of a parametric amplifier using transistors operating beyond cut-off frequency.

621.375.9:621.372.44:621.385.63 **4061**

Microwave Amplification in Electrostatic Ring Structures.—Bass. (See 4365.)

621.375.9:621.382.23 **4062**

On the Cascaded Tunnel-Diode Amplifier.—P. M. Chirlian. (*Proc. Inst. Radio Engrs*, Sept. 1961, Vol. 49, No. 9, pp. 1434–1435.) A mid-band equivalent circuit of an artificial transmission line is described for use with tunnel diodes in cascade amplifiers (see 3044 of 1960). Only one diode is needed in each stage and the shunt resistor is an ordinary passive component.

GENERAL PHYSICS

537.222.1 **4063**

The Electrostatic Field in Metals, particularly at a Surface against an

Resonance.—F. Ollendorff. (*Arch. Elektrotech.*, 15th Feb. 1961, Vol. 46, No. 1, pp. 1–26.)

537.312.8: 530.145 **4064**

Quantum Theory and Transverse Electromagnetic Phenomena.—E. N. Adams & T. D. Holstein. (*J. Phys. Chem. Solids*, Aug. 1959, Vol. 10, No. 4, pp. 278–296.) A quantum theory of electrical conduction in crossed electric and magnetic fields is given for the limit of very weak scattering.

537.525.72: 530.369 **4065**

A Gas Discharge Connected by Microwaves which Gives Free in Space at the Focus of a Closed Ellipsoid of Revolution.—J. Crotch & H. Kleinschrodt. (*Z. Naturf.*, March 1961, Vol. 16a, No. 3, pp. 320–323.) Brief results were obtained than in earlier experiments (2347 of July).

537.56 **4066**

Electric Field-Induced Anisotropies in an Inhomogeneous Plasma.—L. Monsch. (*Phys. Rev.*, 1st Aug. 1961, Vol. 123, No. 3, pp. 722–726.) Anisotropies in electron diffusion and conductivity can be produced in the absence of a magnetic field.

537.56 **4067**

Nonlinear One-Dimensional Plasma Oscillations.—H. Montgomery. (*Phys. Rev.*, 15th Aug. 1961, Vol. 123, No. 4, pp. 1077–1078.) The Laplace transform technique used to solve the problem of the first-order motions in an unbounded, rarefied, electron plasma is modified to solve the problem to arbitrarily high order.

537.56: 538.56 **4068**

Some Boundary Value Problems Involving Plasma Media.—J. R. Wait. (*J. Res. nat. Bur. Stand., Sect. D*, April–June 1961, Vol. 65D, No. 2, pp. 137–146.) A plasma, consisting of a neutral mixture of electrons, ions and molecules, in the presence of a constant magnetic field H_0, possesses a dielectric constant which is in the form of a tensor. Exact solutions of boundary value problems involving such media are obtained for two-dimensional configurations. Explicit results are given for the reflection coefficients of stratified plasma in planar and cylindrical geometry.

537.56: 538.569 **4069**

Radiation in a Plasma: Part I—Cherenkov Effect.—M. H. Cohen. (*Phys. Rev.*, 1st Aug. 1961, Vol. 123, No. 3, pp. 711–721.) A linear continuum theory in which the e.m. and electroacoustic waves set up in a plasma by arbitrary charge and current sources are found from Maxwell's equations. The results are similar to those of Pines & Bohm (1021 of 1954), although the latter start from the particle viewpoint.

538.566 **4070**

Contribution to the Theory of Mode Conversion.—F. Müller. (*Hochfrequenztech. u. Elektroakust.*, Feb. 1961, Vol. 70, No. 1, pp. 20–25.) Maxwell's equations are formulated for three-dimensional Riemann space (see also 1596 of May). The propagation of a Lecher wave without mode conversion is considered.

538.566: 535.42 **4071**

Diffraction of a Plane Electromagnetic Wave on a Circular Fourier Cylinder.—W. Eggimann. (*Bull. schweiz. elektrotech. Ver.*, 20th May 1961, Vol. 52, No. 10, pp. 377–381.) German version of paper published in *Trans. Inst. Radio Engrs*, July 1960, Vol. MTT-8, No. 4, pp. 480–485.

538.566: 535.42 **4072**

Scattering of Electromagnetic Waves from Concentric Infinite Cylinders.—M. Kerker & E. Matijević. (*J. opt. Soc. Amer.*, May 1961, Vol. 51, No. 5, pp. 506–508.) "The solution for the scattering of radiant energy in the form of electromagnetic waves by concentric isotropic infinitely long circular cylinders is given for the incident energy travelling perpendicular to the cylinder axis."

538.569.4 **4073**

Theory of Resonance Absorption of Energy by a Rotating Solid.—J. Dreitlein & H. Kronmüller. (*Phys. Rev.*, 1st Aug. 1961, Vol. 123, No. 3, pp. 835–852.)

538.569.4: 621.375.9: 535.61-2 **4074**

Use of a Different Type of Fluorescent Material as an Optical Maser.—J. J. Ghaffahian & D. Mergerian. (*Nature, Lond.*, 5th Aug. 1961, Vol. 191, No. 4789, pp. 586–588.) A device is suggested which is based on the Stokes' shift associated with absorption and emission bands created by point defects in solids such as KCl. Preliminary calculations indicate that such a device can be made to operate.

538.569.4: 621.375.9: 535.61-2 **4075**

Generation of Optical Harmonics.—P. A. Franken, A. E. Hill, C. W. Peters & G. Weinreich. (*Phys. Rev. Lett.*, 15th Aug. 1961, Vol. 7, No. 4, pp. 118–119.) Analysis is given together with a description of experimental observation of the second harmonic produced by projecting an intense beam of 6 943-Å light through crystalline quartz.

538.569.4: 621.375.9: 535.61-2 **4076**

Stimulated Optical Emission in Fluorescent Solids: Part I—Theoretical Considerations.—T. H. Maiman. (*Phys. Rev.*, 15th Aug. 1961, Vol. 123, No. 4, pp. 1145–1150.)

538.569.4: 621.375.9: 535.61-2 **4077**

Stimulated Optical Emission in Fluorescent Solids: Part 2—Spectroscopy and Stimulated Emission in Ruby.—T. H. Maiman, R. H. Hoskins, I. J. D'Haenens, C. K. Asawa & V. Evtuhov. (*Phys. Rev.*, 15th Aug. 1961, Vol. 123, No. 4, pp. 1151–1157.)

538.569.4: 621.375.9: 535.61-2 **4078**

Fluorescence and Optical Maser Effects in CaF_2:Sm^{++}.—W. Kaiser, C. G. B. Garrett & D. L. Wood. (*Phys. Rev.*, 1st Aug. 1961, Vol. 123, No. 3, pp. 766–776.)

538.691 **4079**

Electron Trajectories in a Nonuniform Axially Symmetric Magnetic Field.—D. A. Dunn & R. E. Holaday. (*J. appl. Phys.*, Aug. 1961, Vol. 32, No. 8, pp. 1612–1620.) The equations for motions for electrons in a sinusoidally varying magnetic field have been solved. A device for converging a hollow cylindrical electron beam designed and built on the basis of the solutions, gave measured area convergences of 13 to 1.

538.2: 537.311.1 **4080**

Energy Bands in the Presence of an External Force Field: I—Semiclassical Velocities.—E. N. Adams & E. I. Blount. (*J. Phys. Chem. Solids*, Aug. 1959, Vol. 10, No. 4, pp. 286–303.) The theory of field-modified energy bands is extended to include the effect of weak scattering forces. The modified current operator is found to contain terms giving anomalous currents. The theory of these currents is developed and their relation to the spontaneous Hall effect in ferromagnets is considered.

GEOPHYSICAL AND EXTRATERRESTRIAL PHENOMENA

523.164: 523.165 **4081**

Spectrum of Galactic Radio Emission.—P. G. Smith. (*Nature, Lond.*, 30th Sept. 1961, Vol. 191, No. 4796, p. 1301.) A discrepancy between theoretical and experimental values of α, the radio spectral index, is discussed. New observations at 408 Mc/s are consistent with $\alpha = 0.37$, the value previously obtained.

523.164: 551.510.52 **4082**

Gutenberg Scintillations and the Ionized Zone.—P. A. Forsyth & K. V. Paulson. (*Canad. J. Phys.*, April 1961, Vol. 39, No. 4, pp. 402–406.) Scintillations at 18 Mc/s over a 6-year period are analysed. The dependence on the altitude of the source was much stronger in 1955 than in 1958. The scintillations probably arise in regions of the atmosphere which migrate northwards when solar activity is high.

523.164.3 **4083**

Radio Spectrum of Jupiter.—A. G. Smith. (*Science*, 1st Sept. 1961, Vol. 134, No. 3478, pp. 387–395.) Review of the results of radio observations from 1955 to the present. 35 references.

523.164.32 **4084**

The Solar Noise Burst of November 12, 1960.—A. E. Covington, G. A. Harvey & L. R. McNairy. (*Canad. J. Phys.*, April 1961, Vol. 39, No. 4, pp. 635–636, plate.) A description of the noise received at 2 800 and 40 Mc/s.

523.164.32 **4085**

Spectral Characteristics of Type II Solar Radio Bursts.—P. A. Sturrock. (*Nature, Lond.*, 7th Oct. 1961, Vol. 192, No. 4797, p. 58.) An explanation of (a) the appearance of radiation only at fundamental and second harmonic frequencies and (b) the frequent splitting observed in these lines is given. See also Roberts (3816 of 1960).

523.164.32 **4086**

Decimetre Radio Bursts Concurrent with Solar Type IV Radiation.—T.

Krishnan & R. F. Mullaly. (*Nature, Lond.*, 7th Oct. 1961, Vol. 192, No. 4797, pp. 58–59.) Measurements taken during a Type IV burst show that radiation at 1 420 Mc/s can originate in a part of the sun's atmosphere widely different from the source of 45–60-Mc/s radiation.

523.164.32: 523.75 **4087**

Coincidence of the Explosive Phase of Solar Flares with 10·7 cm Solar Noise Bursts.—A. E. Covington & G. A. Harvey. (*Nature, Lond.*, Oct. 1961, Vol. 192, No. 4798, pp. 152–153.) Comparison of commencement times of 10·7-cm solar noise bursts with those of the observed explosive phase of solar flares shows good correlation.

523.164.4 **4088**

Amplitude and Angular Scintillations of the Radio Source Cygnus-A Observed at Boulder, Colorado.—R. S. Lawrence, J. L. Jesperson & R. C. Lamb. (*J. Res. nat. Bur. Stand.*, July/Aug. 1961, Vol. 65D, No. 4, pp. 333–350.) Comparison with records from a suitably-placed ionosonde shows correlation between scintillations and spread-F, but not with E_s. The angular dependence of scintillations shows that the ionospheric irregularities are anisotropic. During the day slow, irregular variations of angle occur, and are attributed to large-scale lens-like irregularities.

523.165 **4089**

Intensity Variations in Outer Van Allen Radiation Belt.—S. E. Forbush, D. Venkatesan & C. E. McIlwain. (*J. geophys. Res.*, Aug. 1961, Vol. 66, No. 8, pp. 2275–2287.) Count rates observed with Explorer VII during stormy periods (October–December 1959) indicate a decrease outside 3·5 earth radii during the main phases. The lower cut-off values on the counters are 18 MeV for protons, 1 MeV for electrons. The proportion of soft radiation increases during periods of increased intensity.

523.165 **4090**

Some Effects of Diamagnetic Ring Currents on Van Allen Radiation.—A. J. Dessler & R. Karplus. (*J. geophys. Res.*, Aug. 1961, Vol. 66, No. 8, pp. 2289–2295.) A qualitative theoretical model is proposed to explain the depletion of the outer Van Allen belt during the main phase of a storm. The theory incorporates a magnetic tail on the dark side of earth, a ring current centred at 4–6 earth radii and local betatron acceleration and deceleration of Van Allen and solar particles.

523.165 **4091**

Energy Spectrum and Angular Distributions of Electrons Trapped in the Geomagnetic Field.—J. B. Cladis, L. F. Chase, Jr, W. L. Imhof & D. J. Knecht. (*J. geophys. Res.*, Aug. 1961, Vol. 66, No. 8, pp. 2297–2312.) Count rates taken during a sounding rocket flight to 1 045 km are used to derive distributions of pitch angles at various heights and the energy spectrum. The latter was found to be constant above 600 km. Electron flux for energies >50 keV at apogee was $(4{\cdot}2 \pm 0{\cdot}8) \times 10^6$ cm^{-2} sec^{-1}.

523.165 **4092**

The Observed Outer-Belt Electron Distribution and the Neutron Decay Hypothesis.—W. N. Hess, J. Killeen, C. Y. Fan, P. Meyer & J. A. Simpson. (*J. geophys. Res.*, Aug. 1961, Vol. 66, No. 8, pp. 2313–2314.) The electron flux distribution along a line of force of range 21 000 km in the equatorial plane is compared with a curve based on the neutron albedo theory of electron production. There is sufficient disparity between the two curves to suggest that other sources of electrons must exist.

523.165 **4093**

Unusual Increase in the Cosmic-Ray Intensity on November 20, 1960.—M. A. Pomerantz & S. P. Duggal. (*J. Franklin Inst.*, April 1961, Vol. 271, No. 4, pp. 327–335.) Observations at arctic and antarctic stations show a statistically significant anisotropy.

523.3: 621.396.96 **4094**

Radar Scattering Cross-Section—Applied to Moon Return.—Hayre. (See 4155.)

523.5: 621.396.96 **4095**

The Latitude Dependence of Radar Meteor Shower Observations.—C. S. L. Keay & C. Ellyett. (*J. geophys. Res.*, Aug. 1961, Vol. 66, No. 8, pp. 2337–2343.) A simplified method of assessing the relative significance of meteor showers is described which leads to good agreement between surveys in both hemispheres.

523.5: 621.396.96 **4096**

Head Echoes from Meteor Trails.—J. S. Greenhow. (*J. atmos. terr. Phys.*, Sept. 1961, Vol. 22, No. 1, pp. 64–74.) Head echoes are often reflected from regions up to 100 km in length which may persist for many seconds after the passage of the meteor. The consequences of this fact are discussed.

523.72: 523.165 **4097**

Solar X Rays.—R. W. Kreplin. (*Ann. Géophys.*, April–June 1961, Vol. 17, No. 2, pp. 151–161. In English.) Measurements of the intensity of solar X rays made during the past eleven years using rockets are reviewed and a useful table showing intensities as a function of wavelength and solar activity is given.

523.72: 551.510.535 **4098**

Preliminary Data on Solar Extreme Ultraviolet Radiation in the Upper Atmosphere.—H. E. Hinteregger. (*J. geophys. Res.*, Aug. 1961, Vol. 66, No. 8, pp. 2367–2380.) A rocket-borne monochromator was flown in August 1960. The intensity of the solar spectrum from 260–1 300 Å was scanned in 10 sec at a series of heights up to 235 km. Tables of the intensities, extrapolated to a height above the earth's atmosphere, are given together with absorption cross-sections and other useful information. For completeness, similar tables are given for wavelengths outside the range covered by the August measurements.

523.745 **4099**

Secular Variations of Short-Lived Sunspots.—T. S. Ringnes. (*Nature, Lond.*, 14th Oct. 1961, Vol. 192, No. 4798, pp. 151–152.)

550.38 **4100**

Geomagnetism in Relation to Aeronomy.—E. H. Vestine. (*Ann. Géophys.*, April–June 1961, Vol. 17, No. 2, pp. 181–194. In English.) A brief review dealing with quiet-day and storm variations and associated current systems, the motion of particles trapped in the radiation belts, and phenomena in the outer atmosphere. 57 references.

550.385.4 **4101**

Geomagnetic Variations between November 12 and November 16, 1960.—E. R. Niblett. (*Canad. J. Phys.*, April 1961, Vol. 39, No. 4, pp. 619–622.)

550.385.4 **4102**

On the Reflection and Refraction of Hydromagnetic Waves in Ionized Gas.—T. Namikawa. (*J. Geomag. Geoelect.*, 1961, Vol. 12, No. 3, pp. 117–128.) Reflection and refraction of hydromagnetic waves at a plane boundary between two semi-infinite homogeneous media of anisotropic electrical conductivity are considered for the case of a steady uniform magnetic field perpendicular to the plane. Difficulties in obtaining solutions when the field is at other angles are demonstrated.

550.385.4: 551.594 **4103**

Electric Currents associated with Geomagnetic Disturbances in the Auroral Zone.—F. J. Scrase. (*Nature, Lond.*, 2nd Sept. 1961, Vol. 191, No. 4792, pp. 963–966.) Currents of the order of 10^6 A have been observed at Lerwick during bay-type disturbances. A west-to-east maximum occurred between 1700 and 1800 G.M.T., zero current at 2100 and an east-to-west peak was measured at about midnight. The west-to-east current was at the level of the F layer and the east-to-west current near E-layer level.

550.386.6 **4104**

The Diurnal Variation of *K* Indices of Geomagnetic Activity on Disturbed Days in 1940–1948.—S. B. Nicholson & O. R. Wulf. (*J. geophys. Res.*, Aug. 1961, Vol. 66, No. 8, pp. 2399–2404.)

551.507.362.2 **4105**

Analysis of Satellite Data.—D. G. Parkyn. (*Nature, Lond.*, 26th Aug. 1961, Vol. 191, No. 4791, pp. 896–897.) From an analysis of the orbit of satellite 1958 δ_2 atmospheric density variations have been isolated which are tentatively ascribed to third-harmonic tides.

551.507.362.2 **4106**

Errors in Orbital Predictions for Artificial Satellites of Earth.—K. Moe. (*Nature, Lond.*, 14th Oct. 1961, Vol. 192, No. 4798, p. 151.)

551.507.362.2 **4107**

Atmospheric Densities at Heights of 180–700 km.—D. G. King-Hele & D. M. C. Walker. (*Ann. Géophys.*, April–June 1961, Vol. 17, No. 2, pp. 162–171. In English.) Atmospheric densities determined from changes in the orbits of 22 earth satellites are discussed.

551.507.362.2 **4108**

Determination of Atmospheric Densities from Satellite Observations.—C. A. Whitney. (*Ann. Géophys.*, April–June 1961, Vol. 17, No. 2, pp. 237–244. In English.) A discussion of the errors arising from various factors involved in the determination of upper-atmosphere densities from satellite drag measurements.

551.507.362.2 : 061.3 **4109**

Proceedings of the Fourth AFBMD/STL Symposium: Advances in Ballistic Missile and Space Technology.—(*Planet. Space Sci.*, July 1961, Vol. 7, pp. 1–462.) The text is given of 45 papers on various aspects of rocket and satellite techniques including instrumentation, space guidance and computers. For papers on space communications, see e.g. 4298 below.

551.507.362.2 : 523.164 **4110**

Proposed Satellite Techniques for Performing a High-Resolution Survey of the Radio Sky at Medium Wavelengths.—R. C. Jennison. (*J. Brit. Instn Radio Engrs*, Sept. 1961, Vol. 22, No. 3, pp. 205–208.) The reception pattern of a short dipole above the F layer is modified by refraction in the ionized medium. The properties of this pattern are discussed and satellite experiments using this phenomenon are suggested.

551.507.362.2 : 523.165 **4111**

Satellite-Borne Instrumentation for Observing Flux of Heavy Primary Cosmic Radiation.—P. Schwed, M. A. Pomerantz, H. Hanson & H. Benjamin. (*J. Franklin Inst.*, April 1961, Vol. 271, No. 4, pp. 275–291.)

551.507.362.2 : 523.165 **4112**

Cosmic-Ray Measurements in the U.K. Scout I Satellite.—H. Elliott, J. J. Quenby, D. W. Mayne & A. C. Durney. (*J. Brit. Instn Radio Engrs*, Sept. 1961, Vol. 22, No. 3, pp. 251–256.) The main purpose is to measure accurately the primary cosmic-ray energy spectrum and the changes in it due to modulation by the interplanetary magnetic field. G-M counters and a Cherenkov counter will be used.

551.507.362.2 : 621.38 : 539.12.04 **4113**

Radiation and other Environmental Effects on Satellites.—R. Innes. (*J. Brit. Instn Radio Engrs*, Sept. 1961, Vol. 22, No. 3, pp. 241–250.) Transistor failure in a satellite spending an appreciable part of its life in the inner Van Allen belt seems likely after several years. Solar cells cannot be effectively protected from hard radiation.

551.510.535 **4114**

Lyman-α Radiation.—H. Friedman. (*Ann. Géophys.*, April–June 1961, Vol. 17, No. 2, pp. 245–248. In English.) The role of Lyman α in the ionization of the D region is discussed. Nocturnal observations of Lyman α which lead to the concept of the hydrogen geocorona are reviewed.

551.510.535 **4115**

Theory of Electrostatic Fields in the Ionosphere at Equatorial Latitudes.—J. R. Spreiter & B. R. Briggs. (*J. geophys. Res.*, Aug. 1961, Vol. 66, No. 8, pp. 2345–2354.) An analysis is made of the elongated e.s. fields required to provide the E- and F-layer coupling in the dynamo theory, for equatorial conditions. The attenuation of the e.s. field is found to be large, implying very small coupling, for fields with horizontal wavelengths of a few km; most of this attenuation occurs at heights near the E region. For an analysis in non-equatorial regions see 3393 of October.

551.510.535 **4116**

Apparent Reflection Heights and Reflection Properties of the Ionosphere above Tsumeb, South-West Africa, determined by means of Pulses in the Frequency Band from 350 to 5 600 kc/s.—W. Elling. (*Arch. elekt. Übertragung*, March 1961, Vol. 15, No. 3, pp. 115–124.) The results of nighttime ionospheric measurements made during the period August 1957–March 1958 are analysed to determine the electron density distribution below the F layer. At least three ledges in the electron distribution were regularly observed at heights between 110 and 170 km and in the lower E region. The occurrence of E_s layers was also noted.

551.510.535 **4117**

Comparison of Absorption Coefficients of the Ionosphere from Pulse Amplitude Measurements and Field-Strength Recordings.—H. Schwentek & G. Umlauft. (*Arch. elekt. Übertragung*, April 1961, Vol. 15, No. 4, pp. 200–204.) Ionospheric absorption was measured by two methods: (*a*) vertical-incidence soundings at 1·73 Mc/s; (*b*) field-strength measurements over an oblique-incidence path 295 km in length, at 2·61 Mc/s. These frequencies are such that in both methods, the heights of reflection are equal. The absorption coefficients determined using the two methods have a correlation coefficient of 0·84 for both daily and monthly mean values, and are related to each other by the square of the effective frequency ($f + f_L$).

551.510.535 **4118**

The Ionospheric Disturbance of November 12 and 16, 1960.—W. S. Campbell & P. L. Hubert. (*Canad. J. Phys.*, April 1961, Vol. 39, No. 4, pp. 614–616.) Changes in ionospheric absorption as shown by f_{min} are discussed.

551.510.535 **4119**

Nocturnal and Seasonal Variations of Equatorial Spread-F.—M. S. V. G. Rao & B. R. Rao. (*J. atmos. terr. Phys.*, Sept. 1961, Vol. 22, No. 1, pp. 12–22.) A classification of spread-echo patterns based on the distribution of relative amplitude within the echo is described. The variations in spread-F index at Waltair (7·4°N geomag.) are compared with those at Kodaikanal (0·6°N geomag.).

551.510.535 : 523.164 **4120**

Measurement of Ionospheric Drift by Radio-Star Observations.—B. Dueño. (*J. geophys. Res.*, Aug. 1961, Vol. 66, No. 8, pp. 2355–2365.) The incidence of scintillations is greatest in the hours before sunrise at Puerto Rico; it is not correlated with spread-F or E_s. The drift results show that the ionosphere irregularities causing scintillation are elongated along the lines of force of the geomagnetic field, and that drift, rather than random changes, is the main source of scintillation.

551.510.535 : 523.164 **4121**

A Method of Estimating Ionospheric Absorption Heights from Recovery Times.—S. Ziauddin. (*Nature, Lond.*, 9th Sept. 1961, Vol. 191, No. 4793, pp. 1084–1085.) Rapid recovery from absorption occurs when the ionizing source is suddenly cut off. From a plot of ionospheric relaxation time against height an estimate can be made of the height of the absorbing layer which is in good agreement with measurements made by the three-frequency riometer method.

551.510.535 : 523.164 **4122**

Ionospheric Absorption on November 12, 1960.—E. L. Vogan & T. R. Hartz. (*Canad. J. Phys.*, April 1961, Vol. 39, No. 4, pp. 630–635.) The results obtained using riometers in Canada are described.

551.510.535 : 523.745 **4123**

Ionospheric Absorption and Solar Activity in Intermediate Latitudes.—M. Anastassiades, D. Ilias & C. Caroumbalos. (*Ann. Géophys.*, April–June 1961, Vol. 17, No. 2, pp. 256–260.) Measurements of the absorption of cosmic noise were made at Athens on 27·6 and 58 Mc/s. Analysis of the data allowed the components of the total absorption due to the F and D layers and the extra component to be estimated.

551.510.535 : 523.75 **4124**

Ionospheric Current Systems of Ten I.G.Y. Solar-Flare Effects.—D. Van Sabben. (*J. atmos. terr. Phys.*, Sept. 1961, Vol. 22, No. 1, pp. 32–42.) The current systems consist of two vortices, one on each side of the magnetic equator. The northern vortex is centred west of the southern one and is more intense in local summer than the southern one. The asymmetry in the vortices can be described in terms of an ionospheric current system.

551.510.535 : 550.385.2 **4125**

Ionospheric Critical Frequencies and Magnetic Parameters of the Day Before.—H. W. Bergh & J. W. King. (*J. atmos. terr. Phys.*, Sept. 1961, Vol. 22, No. 1, pp. 74–75.) The correlation between f_0F_2 at 0300 and 0500 L.M.T. at Capetown and local magnetic activity K was calculated. The correlation is greatest when the magnetic indices for the previous day are used. This is true both when 24-h and 6-h means of K are used in the correlations.

551.510.535 : 550.385.37 **4126**

Connexion between Micropulsations and the Ionosphere.—C. M. Lock & P. J. Stevens. (*Nature, Lond.*, 5th Aug. 1961, Vol. 191, No. 4788, pp. 584–585.) Measurements made at Christchurch, England, and Ascension Island 6 750 km distant show that P_i pulses occur simultaneously at both stations but the same coherence is not observed for P_c pulsations.

551.510.535 : 551.507.362.1 **4127**

Atmospheric Ion Compositions Measured above Wallops Island, Virginia.

—H. A. Taylor, Jr, & H. C. Brinton. (*J. geophys. Res.*, Aug. 1961, Vol. 66, No. 8, pp. 2587–2588.) Preliminary data for heights between 100 and 250 km, obtained from two rocket flights, are given and compared with results of previous determinations.

551.510.535: 551.507.362.2 **4128**

Ionospheric Information Deduced from the Doppler Shifts of Harmonic Frequencies from Earth Satellites.—O. K. Garriott & A. W. Nichol. (*J. atmos. terr. Phys.*, Sept. 1961, Vol. 22, No. 1, pp. 50–63.) Measurements made near the end of the life of Sputnik III have indicated the presence of appreciable ionization at a height of 90 km in the daytime and have revealed the existence of ionospheric irregularities below 175 km.

551.510.535: 551.507.362.2 **4129**

Height of Nighttime F-Layer Irregularities at the Equator.—G. S. Kent & J. R. Koster. (*Nature, Lond.*, 9th Sept. 1961, Vol. 191, No. 4793, pp. 1083–1084.) Satellite transmissions propagated through the irregularities produce a diffraction pattern from whose velocity the effective height of the diffracting screen may be determined. Irregularities are elongated with axial ratio at least 7 : 1 along the earth's magnetic field and lie between 50 and 400 km above the base of the F layer.

551.510.535: 621.3.087.4 **4130**

The Determination of the Absorption of the Ionosphere from Pulse Amplitude Observations.—G. Umlauft. (*Arch. tech. Messen*, March 1961, No. 302, pp. 53–56.) Equipment for measuring ionospheric absorption by means of vertical-incidence soundings is described. It operates at 1–75 or 2–23 Mc/s with pulse width variable between 50 and 500 μs. Details are given of the polarimeter receiving circuit. See also 4117 above.

551.510.535: 621.391.812.63 **4131**

On the Validity of some Approximations to the Appleton-Hartree Formula.—Davies & King. (See 4277.)

551.510.535: 621.391.812.63 **4132**

Investigation of Ionospheric Absorption on 5·65 Mc/s at Waltair.—Ramana & Rao. (See 4279.)

551.510.535: 621.391.812.63 **4133**

The Fading of Radio Waves Reflected Vertically from the Ionosphere during Magnetic Storms.—G. F. Fooks. (*J. atmos. terr. Phys.*, Sept. 1961, Vol. 22, No. 1, pp. 43–49.) Correlation analysis is applied to the spread, rapidly fading reflection observed at Cambridge (52°N) during magnetic storms. The drift velocity is usually large and towards the West, and the direction of elongation of the diffraction pattern shows that the ionospheric irregularities are aligned with the earth's magnetic field.

551.510.535: 621.396.676 **4134**

The Electrically Short Antenna as a Probe for Measuring Free Electron Densities and Collision Frequencies in an Ionized Region.—R. King, C. W. Harrison, Jr, & D. H. Denton, Jr. (*J. Res. nat. Bur. Stand.*, July/Aug. 1961, Vol. 65D, No. 4, pp. 371–384.) The integral-equation method is used to obtain expressions for the admittance of an electrically short centre-driven dipole or base-driven monopole when immersed in a conducting dielectric. The conductivity and permittivity of the medium can be calculated from measurements of the admittance of the aerial immersed in the medium and in air.

551.510.535: 681.142 **4135**

An Analogue Solution of the Continuity Equation of the Ionospheric F Region.—B. H. Briggs & H. Rishbeth. (*Proc. phys. Soc.*, 1st Sept. 1961, Vol. 78, No. 501, pp. 409–422.) An electromechanical analogue computer is used to solve an idealized F-layer continuity equation. The results show how the layer above the F_2 peak is mainly controlled by vertical diffusion of ionization, and below the peak by the production and loss processes. The machine can also simulate the effect of a solar eclipse.

551.510.535/98): 523.75 **4136**

Effects of Corpuscular Emissions on the Polar Ionosphere Following Solar Flares.—G. E. Hill. (*J. geophys. Res.*, Aug. 1961, Vol. 66, No. 8, pp. 2329–2335.) During the events of 24th–25th July and 19th–22nd September 1957, ionospheric absorption was more intense in the sunlit portion of the polar cap. After the September event, there was strong auroral absorption, a geomagnetic storm and a decrease in F_2-layer ionization; none of these occurred after the July event.

551.510.535/99: 621.391.812.63 **4137**

Ionospheric Reflections below 50 Kilometres during Polar-Cap Absorption Events.—J. B. Gregory. (*J. geophys. Res.*, Aug. 1961, Vol. 66, No. 8, pp. 2575–2577.) Vertical-incidence A'(z) observations on 2–3 Mc/s at Scott Base (latitude 78°S) showed partial reflections from heights below 50 km during two polar-cap absorption events. The results are correlated with measurements made in space vehicles during the same period.

551.510.536: 551.594.6 **4138**

Electron Densities in the Outer Ionosphere Deduced from Nose Whistlers.—R. L. Smith. (*J. geophys. Res.*, Aug. 1961, Vol. 66, No. 8, pp. 2570–2579.) Comment on 1549 of May (Pope).

551.510.536: 551.594.6 **4139**

Some Comments on Obtaining Electron Densities in the Exosphere using Nose Whistlers.—J. H. Pope. (*J. geophys. Res.*, Aug. 1961, Vol. 66, No. 8, pp. 2580–2581.) Discussion of a paper by Smith (see 4138 above).

551.593.5 **4140**

Variations of [OI] 5577-Å Emission in the Upper Atmosphere.—F. E. Roach. (*Ann. Géophys.*, April–June 1961, Vol. 17, No. 2, pp. 172–180. In English.) A review of experimental data, with consideration of excitation mechanisms and relations with other airglow emissions.

551.593.5 **4141**

A Simultaneous Study of the λλ 5577, 5893 and 6300 Emissions of the Night Airglow at Poona.—M. W. Chiplonkar & V. V. Agashe. (*Ann. Géophys.*, April–June 1961, Vol. 17, No. 2, pp. 231–236. In English.) Results of measurements made in early 1960.

551.594 **4142**

Hydrogen Emissions during the Period November 9–16, 1960.—R. Montalbetti & D. J. McEwen. (*Canad. J. Phys.*, April 1961, Vol. 39, No. 4, pp. 617–619.)

551.594: 621.396.9 **4143**

Power Density Requirements for Airglow Excitation by Gyro-waves.—V. A. Bailey. (*J. Res. nat. Bur. Stand.*, July/Aug. 1961, Vol. 65D, No. 4, pp. 321–322.) An array of 80 dipoles radiating a gyro-wave with a mean power of 500 kW would produce an easily observable enhancement of the nocturnal airglow overhead within a solid angle of 32 square degrees.

551.594.5 **4144**

Temperatures Deduced from Aurora and Airglow Spectra.—D. M. Hunten. (*Ann. Géophys.*, April–June 1961, Vol. 17, No. 2, pp. 249–255. In English.) Several experimental results are combined to give a temperature profile between 70 and 250 km.

551.594.5 **4145**

Observations of Auroral Ionization during the Period November 11–16, 1960.—H. V. Seaton & B. C. Blevis. (*Canad. J. Phys.*, April 1961, Vol. 39, No. 4, pp. 622–625.) Auroral luminosity and radar echo amplitude at 408 and 944 Mc/s were observed.

551.594.5: 523.164 **4146**

Three-Frequency Measurements of Auroral Absorption.—S. Zmuidzinas & P. A. Forsyth. (*J. geophys. Res.*, Aug. 1961, Vol. 66, No. 8, pp. 2315–2319.) The ratio of the measured absorption of cosmic noise during auroral events was measured on two pairs of frequencies near 30 Mc/s. Assuming that the electron collision frequency as a function of height is known, the height at which the absorption occurs can be estimated. Heights of 50–70 km were usual for intense auroral events, but lower heights were observed for cosmic-ray events.

551.594.5: 621.396.96 **4147**

Auroral Observations by Radar in Terre Adélie (Nov. 1957–Jan. 1958).—K. Bullough. (*C. R. Acad. Sci., Paris*, 14th Nov. 1960, Vol. 251, No. 20, pp. 2222–2223.) Observations made during the southern summer show a correlation between the geomagnetic latitude of the echoes and the K_p value. For full report see *Ann. Géophys.*, April–June 1961, Vol. 17, No. 2, pp. 195–230.

551.594.5: 621.396.96 **4148**

Auroral Radar Observations at 48 Mc/s during the Period of the 12 November, 1960, Solar Event.—A. G. McNamara. (*Canad. J. Phys.*, April 1961, Vol. 39, No. 4, pp. 625–627.)

551.594.6 **4149**

Extension of Nose Whistler Analysis.—R. L. Smith & D. L. Carpenter. (*J. geophys. Res.*, Aug. 1961, Vol. 66, No. 8, pp.

2562–2586.) A method of analysis is described which gives the nose frequency and the time delay to the nose when the nose is not directly observable.

LOCATION AND AIDS TO NAVIGATION

534.88 **4150**

Consideration of the Problem of Optimum Frequency in Underwater Sonar Systems.—H. Thiele. (*Arch. elekt. Übertrag.*, 1961, Vol. 11, No. 1, pp. 22–25. In German.) The optimum frequencies of sonar systems for obtaining a given range are determined taking account of the frequency-dependent parameters of sound propagation in sea water. The relation between range and minimum areas of radiating surface is also calculated.

621.396.9: 551.507.362.2 **4151**

Instrumentation and Telemetry of Transit Navigational Satellites.—J. W. Hamblen & J. B. Oakes. (*Electronics*, 11th Aug. 1961, Vol. 34, No. 32, pp. 140–143.) The system is based on the accurate measurement information obtainable from the Doppler shift of the signal from a satellite. The experimental satellite described has four transmitters operating between 50 and 324 Mc/s, driven from a single-frequency source accurate to within a few parts in 10^{10}. Operational, constructional and circuit details are given.

621.396.9: 629.19.03:8 **4152**

Inertial Systems in Space Vehicles.—M. A. V. Matthews. (*J. Brit. Instn Radio Engrs*, Sept. 1961, Vol. 22, No. 3, pp. 231–239.) A discussion of the advantages and disadvantages when used in conjunction with radio methods.

621.396.933.2: 621.396.67 **4153**

The Application of the Interferometer to H.F. Direction Finding.—C. W. McLeish & N. Burtonyk. (*Proc. Instn elect. Engrs*, Part B, Sept. 1961, Vol. 108, No. 41, pp. 495–499.) A considerable reduction in bearing error, compared with a narrow-aperture system, is obtained in the presence of interference. A standard deviation of 1·2° was obtained with a 400-ft interferometer on skywave transmission at 5–25 Mc/s.

621.396.933.2: 621.396.67 **4154**

Antenna Coupling Error in Direction Finders.—C. W. Harrison, Jr. (*J. Res. nat. Bur. Stand.*, July/Aug. 1961, Vol. 65D, No. 4, pp. 363–369.) "Antenna coupling or scattering error in an interferometer-angle-measuring system consisting of two identical base-loaded quarter-wave vertical antennas over a perfectly conducting earth is investigated. A curve is supplied for the error in angle as a function of antenna spacing for an incident vertically polarized electric field arriving in the plane of the antennas, when the ratio of antenna length to radius is 75 and the base loads are resistors of 50 ohms."

621.396.96: 523.3 **4155**

Radar Scattering Cross-Section—Applied to Moon Return.—H. S. Hayre. (*Proc. Inst. Radio Engrs*, Sept. 1961, Vol. 49, No. 9, p. 1433.) A discussion of the effect of rough terrain on the scattered echo. Results indicate that the effective surface as seen by radar is not as smooth as was assumed by some previous authors.

621.396.96: 621.374.5 **4156**

The Delay-Lock Discriminator—an Optimum Tracking Device.—J. J. Spilker, Jr, & D. T. Magill. (*Proc. Inst. Radio Engrs*, Sept. 1961, Vol. 49, No. 9, pp. 1403–1416.) A statistically optimum device for the measurement of the delay between two correlated waveforms. A nonlinear feedback system including a variable delay line is used. The theory and operation are described.

621.396.96: 621.391.82 **4157**

Search-Radar Analogue Simulator Reproduces Jamming, Scintillation.—L. G. Fischer & G. Frenkel. (*Electronics*, 25th Aug. 1961, Vol. 34, No. 34, pp. 58–60.) Simulated signals are injected at i.f. into a radar set.

621.396.962.3 **4158**

An Interpretation of 'Paired Echo Theory' for Time-Domain Discretion in Pulsed Systems and an Extension to the Radar 'Uncertainty Function'.—J. V. DiFranco & W. L. Rubin. (*Proc. Inst. Radio Engrs*, Sept. 1961, Vol. 49, No. 9, pp. 1432–1433.) A discussion of the application of Fourier analysis in determinations of distortion in pulse systems and degradation of radar performance.

621.396.962.33: 621.376.23 **4159**

A Sequential Detection System for the Processing of Radar Returns.—A. A. Galvin. (*Proc. Inst. Radio Engrs*, Sept. 1961, Vol. 49, No. 9, pp. 1417–1425.) A two-step filter detection system is described which offers an appreciable reduction in size and complexity of equipment without reduction in performance.

MATERIALS AND SUBSIDIARY TECHNIQUES

535.583: 621.3.032.14 **4160**

Ternary System Th-Ce-Al.—J. H. N. van Vucht. (*Philips Res. Rep.*, Feb. 1961, Vol. 16, No. 1, pp. 1–40.) An investigation of a non-evaporating getter material.

535.215: 546.48'221 **4161**

The Real Structure of CdS Single Crystals.—W. Möhling & H. Thiel. (*Ann. Phys., Lpz.*, 29th March 1961, Vol. 7, Nos. 7–8, pp. 381–385.) Crystal growth and defects were investigated.

535.215: 546.48'221 **4162**

Absorption Spectra of Transition Ions in CdS Crystals.—R. Pappalardo & R. E. Dietz. (*Phys. Rev.*, 15th Aug. 1961, Vol. 123, No. 4, pp. 1188–1203.)

535.215: 546.48'221 **4163**

Effects of Vacancies on Pulse Photoconduction in CdS Single Crystals.—J. Shirafuji & Y. Inuishi. (*J. phys. Soc. Japan*, April 1961, Vol. 16, No. 4, p. 832.) Cd vacancies shorten electron lifetimes at low temperatures. S vacancies enhance the quantum efficiency and increase the lifetime.

535.215: 546.48'221: 534.283.8 **4164**

Photosensitive-Ultrasonic Properties of Cadmium Sulphide.—H. D. Nine & R. Truell. (*Phys. Rev.*, 1st Aug. 1961, Vol. 123, No. 3, pp. 799–803.) Ultrasonic attenuation is found to vary with light irradiation, some crystals showing a decrease and others an increase. The latter effect is explicable by piezoelectric coupling between conduction electrons and stress waves.

535.215: 546.682'221 **4165**

Photoconductivity in Indium Sulphide Powders and Crystals.—R. H. Bube & W. H. McCarroll. (*J. Phys. Chem. Solids*, Aug. 1959, Vol. 10, No. 4, pp. 333–335.)

535.376: 546.47'221 **4166**

The Influence of Temperature on Field Enhancement and Field Quenching of Cathodoluminescence.—H. Gobrecht, H. E. Gumlich & J. zum Busch. (*Z. Phys.*, 17th March 1961, Vol. 162, No. 2, pp. 169–179.) Further results of investigations on ZnS-Mn. See also 100 of February (Gobrecht & Gumlich).

535.376: 546.47'221 **4167**

Infrared Emission and Electroluminescence in Zinc Sulphide Phosphors.—D. W. G. Balkenende. (*Proc. phys. Soc.*, 1st Sept. 1961, Vol. 78, No. 503, pp. 348–353.) Experimental results show that infrared emission does not occur in materials with high Cu concentration, and was not detected during electroluminescence.

535.376: 546.48'47'221 **4168**

Electrophotoluminescence of a Zinc-Cadmium-Sulphide Phosphor as a Function of Excitation Wavelength and Width of Field Pulse.—H. Gutjahr & F. Mattoni. (*Z. Phys.*, 3rd March 1961, Vol. 162, No. 1, pp. 105–113.)

537.227: 538.569.4 **4169**

Proton Magnetic Resonance in Ferroelectric $(CH_3NH_3)_2SO_4.12H_2O$.—R. Hoshino. (*J. phys. Soc. Japan*, April 1961, Vol. 16, No. 4, pp. 835–836.)

537.227: 621.318.57 **4170**

Increase in Dielectric Constant during Switching in Lithium Selenite and Triglycine Sulphate.—E. Fatuzzo. (*J. appl. Phys.*, Aug. 1961, Vol. 32, No. 8, pp. 1571–1579.) Changes in dielectric constant were measured during switching up to frequencies of 100 Mc/s. A model to explain the experimental results is given and discussed.

537.228.1: 549.514.51 **4171**

Thickness-Shear-Mode Quartz Cut with Small Second- and Third-Order Coefficients of Frequency (RT-Cut).—R. Bechmann. (*Proc. Inst. Radio Engrs*, Sept. 1961, Vol. 49, No. 9, p. 1454.)

537.311.31 **4172**

Theory of Electron-Phonon Interaction in Metals.—H. Stolz. (*Ann. Phys., Lpz.*, 29th March 1961, Vol. 7, Nos. 7/8, pp. 353–367.) Calculation of matrix elements for phonon absorption or emission on the basis of assumptions also discussed by Whitfield (2146 of July).

537.311.31 **4173**

Electron-Phonon Interaction.—H. Puff. (*Ann. Phys., Lpz.*, 29th March 1961, Vol. 7, Nos. 7/8, pp. 368–370.) See also 4172 above.

537.311.31 **4174**

Electrical Resistivity at Low Temperatures.—J. S. Dugdale. (*Science*, 14th July 1961, Vol. 134, No. 3472, pp. 77–86.) Investigations of the pressure dependence of the electrical resistance of metals at low temperatures are discussed; results are interpreted in terms of Fermi surface displacement and Fermi energy changes.

537.311.31 : 538.569.4 **4175**

Influence of Ferromagnetic Resonance on the Electrical Resistance of a Metal.—A. Bassompierre. (*C. R. Acad. Sci., Paris*, 14th Nov. 1960, Vol. 251, No. 20, pp. 2141–2143.) An examination of the increase in resistance produced by the collision of conduction electrons with misaligned-spin faults caused by ferromagnetic resonance.

537.311.33 **4176**

The Phonon-Assisted Auger Effect in Semiconductors.—D. M. Eagles. (*Proc. phys. Soc.*, 1st Aug. 1961, Vol. 78, No. 500, pp. 204–216.) Some calculations on the effect of phonons on Auger recombination and impact ionization in semiconductors with simple bands are presented.

537.311.33 **4177**

The Possibility of Negative-Resistance Effects in Semiconductors.—B. K. Ridley & T. B. Watkins. (*Proc. phys. Soc.*, 1st Aug. 1961, Vol. 78, No. 500, pp. 293–304.) If carriers in a high-mobility subband are heated with an electric field, they can transfer to a higher- energy low-mobility sub-band. The necessary conditions and possible side effects are discussed.

537.311.33 **4178**

A Relation between the Binding Energy and the Band-Gap Energy in Semiconductors of Diamond or Zinc-Blende Structure.—P. Manca. (*J. Phys. Chem. Solids*, Aug. 1961, Vol. 20, Nos. 3/4, pp. 268–273.) For the binary semiconductors of tetrahedral coordination considered, a linear relation of the type, $E_g = a(E_s - b)$ has been determined empirically where E_g is the gap energy, E_s is the single-bond energy and a and b are characteristic constants of the series $A^{IV}A^{IV}$, $A^{III}B^{V}$, $A^{II}B^{VI}$.

537.311.33 : 546.23 : 537.226 **4179**

Dielectric Relaxation Phenomena in Selenium.—W. Ludwig & F. Eckart. (*Z. Phys.*, 17th March 1961, Vol. 162, No. 2, pp. 127–141.) Measurements of the variation of dielectric loss in the range 0·5–1 000 kc/s and at temperatures from +40 to −160°C, on Br-doped hexagonal Se.

537.311.33 : [546.28 + 546.289 **4180**

Theory of Electrical Conductivity of Ge and Si: Part 1—The Electron-Phonon Matrix Elements.—W. Klose. (*Ann. Phys., Lpz.*, 16th March 1961, Vol. 7, Nos. 5/6, pp. 233–242.) Intravalley and intervalley electron scattering at acoustic and optical phonons is determined using an approximation valid for low temperatures.

537.311.33 : 546.28 **4181**

Properties of Grain Boundaries in Silicon.—Y. Matukura. (*J. phys. Soc. Japan*, April 1961, Vol. 16, No. 4, pp. 842–843.) The grain boundary layer in Si is *n*-type.

537.311.33 : 546.28 **4182**

Diffusion along Small-Angle Grain Boundaries in Silicon.—H. J. Queisser, K. Hubner & W. Shockley. (*Phys. Rev.*, 15th Aug. 1961, Vol. 123, No. 4, pp. 1245–1254.)

537.311.33 : 546.28 : 541.135 **4183**

Saturation Currents in Silicon Electrodes.—G. Greger. (*Z. Naturf.*, March 1961, Vol. 16a, No. 3, pp. 284–288.) Investigation on *p*- and *n*-type electrodes in various electrolytes. See also 3930 of 1960 (Seipt).

537.311.33 : 546.281'26 **4184**

Lattice Absorption Bands in SiC.—L. Patrick & W. J. Choyke. (*Phys. Rev.*, 1st Aug. 1961, Vol. 123, No. 3, pp. 813–815.)

537.311.33 : 546.289 **4185**

Surface Kinetics and Physics Investigation of the Reaction between Single-Crystal Germanium and Iodine.—W. J. Heinrichs & S. Ing, Jr. (*J. appl. Phys.*, Aug. 1961, Vol. 32, No. 8, pp. 1498–1504.) An activation energy of 18·5 kcal/mol was found for each of the three crystallographic planes studied. Frequency factors differed with orientation.

537.311.33 : 546.289 **4186**

The Adsorption of Chlorine on Clean Germanium Surfaces.—M. Green & K. H. Maxwell. (*J. Phys. Chem. Solids*, Aug. 1961, Vol. 20, Nos. 3/4, pp. 274–280.)

537.311.33 : 546.289 **4187**

Cyclotron-Resonance Measurements of the Energy-Band Parameters of Germanium.—B. W. Levinger & D. R. Frankl. (*J. Phys. Chem. Solids*, Aug. 1961, Vol. 20, Nos. 3/4, pp. 281–288.)

537.311.33 : 546.289 **4188**

Conductivity of Grain Boundaries in Ge.—Y. Matukura & S. Tanaka. (*J. phys. Soc. Japan*, April 1961, Vol. 16, No. 4, pp. 833–834.) The temperature variations of resistivity and Hall coefficient are measured.

537.311.33 : 546.289 **4189**

Electrical Properties of Heavily Doped *n*-Type Germanium.—Y. Furukawa. (*J. phys. Soc. Japan*, April 1961, Vol. 16, No. 4, pp. 687–694.) Experimental studies were made on electrical resistivity, Hall coefficient and magnetoresistance of As-, Sb- and (As + Sb)-doped Ge in the electron concentration range $10^{18} - 3 \times 10^{19}$ cm^{-3}.

537.311.33 : 546.289 **4190**

Regrowth of Germanium from Molten Indium on Lead.—M. Tomono. (*J. phys. Soc. Japan*, April 1961, Vol. 16, No. 4, pp. 711–719.) A single crystal of *n*-type Ge was alloyed with In and the resulting regrowth of *p*-type Ge was observed for various cooling rates.

537.311.33 : 546.289 **4191**

Low-Temperature Electrical Breakdown in Germanium.—J. Yamashita. (*J. phys. Soc. Japan*, April 1961, Vol. 16, No. 4, pp. 720–732.) The breakdown field estimated theoretically is in agreement with experiment when the concentration of donors and acceptors is fairly small.

537.311.33 : 546.57'86'241 **4192**

The Thermal Conductivity of Silver Antimony Telluride.—E. F. Hockings. (*J. Phys. Chem. Solids*, Aug. 1959, Vol. 10, No. 4, pp. 341–342.)

537.311.33 : 546.68'86 **4193**

Temperature Variation of Optical Energy Gap for GaSb-InSb Alloys.—J. C. Woolley & J. A. Evans. (*Proc. phys. Soc.*, 1st Sept. 1961, Vol. 78, No. 501, pp. 354–360.) Absorption measurements show that the energy gap varies linearly with temperature in the range 100–800 °K.

537.311.33 : 546.682'18 **4194**

Electrical Properties of *p*-Type InP.—M. Glicksman & K. Weiser. (*J. Phys. Chem. Solids*, Aug. 1959, Vol. 10, No. 4, pp. 337–340.) A plot on the temperature dependence of the measured Hall mobilities of two Cd-doped samples is given, and the properties of two crystals are tabulated.

537.311.33 : 546.682'86 **4195**

The Diffusion Coefficient of Zinc in Indium Antimonide.—K. F. Hulme & J. E. Kemp. (*J. Phys. Chem. Solids*, Aug. 1959, Vol. 10, No. 4, pp. 335–337.) A value of $1{\cdot}6 \times 10^{6}$ exp. $[(-55\,000 \pm 6\,000)/RT]$ cm^2/sec was obtained using the *p-n* junction method.

537.311.33 : 546.682'86 **4196**

Interpretation of the Anisotropy of the Resistance Change in *n*-Type InSb.—H. Ruppersht. (*Z. Naturf.*, April 1961, Vol. 16a, No. 4, pp. 395–401.) For her investigations of resistivity changes in InSb as a function of growth conditions and doping material. See also 1241 of April (Ruppersht et al.).

537.311.33 : 546.682'86 : 539.12.04 **4197**

Recovery of Electron Radiation Damage in *n*-Type InSb.—F. H. Eisen. (*Phys. Rev.*, 1st Aug. 1961, Vol. 123, No. 3, pp. 736–744.)

537.311.33 : [546.682'86 + 546.682'19 : 539.23 **4198**

Properties of Vapour-Deposited InSb and InAs Films.—K. G. Günther & H. Freller. (*Z. Naturf.*, March 1961, Vol. 16a, No. 3, pp. 279–283.) Further report on results obtained with films prepared by the "three-temperature method" [3349 of 1959 (Günther)].

537.311.33: 546.812.221 4199

Measurement and Analysis of the Infrared Reflection Spectrum of Semiconducting SnS.—C. Haas & M. M. G. Corbey. (*J. Phys. Chem. Solids*, Aug. 1961, Vol. 20, Nos. 3/4, pp. 197–203.)

537.311.33: 546.823-31 4200

Electrical Conduction in *p*-Type Titanium Sesquioxide.—J. Yahia & H. P. R. Frederikse. (*Phys. Rev.*, 15th Aug. 1961, Vol. 123, No. 4, pp. 1257–1261.) Measurements indicate that below 450 °K the crystals behave like semiconductors while above it the conductivity is apparently metallic.

537.311.33: 621.382.23 4201

The Band Structure of Strongly Doped Semiconductors.—G. Wintel & W. Heywang. (*Z. Naturf.*, April 1961, Vol. 16a, No. 4, pp. 440–441.) Theoretical consideration of the discrepancies arising between the conventional band model of doped semiconductors and the measured characteristics of tunnel diodes. See also 4329 below.

537.312.62 4202

A Study of Superconducting *Niobium* by Electron Tunnelling.—P. Townsend & J. Sutton. (*Proc. phys. Soc.*, 1st Aug. 1961, Vol. 78, No. 500, pp. 309–311.)

537.322.1 4203

Peltier Coefficient at High Current Levels.—J. R. Reitz. (*J. appl. Phys.*, Aug. 1961, Vol. 32, No. 8, pp. 1623–1624.) The advantages of a metal weld at the junction of a thermocouple are considered. At high current densities the effect of using a two-metal weld is discussed.

538.221 4204

Experimental Test of the Spin-Wave Theory of a Ferromagnet.—A. C. Gossard, V. Jaccarino & J. P. Remeika. (*Phys. Rev. Lett.*, 15th Aug. 1961, Vol. 7, No. 4, pp. 122–124.)

538.221 4205

The Internal Stress Energy of Bloch Walls.—M. Hicke, E. Max & H. G. Muller. (*Z. angew. Phys.*, March 1961, Vol. 13, No. 3, pp. 125–130.) The internal stress energy is determined on the basis of experimental investigations of Bloch wall shape and compared with the eddy-current energy component in magnetization reversal processes.

538.221 4206

Fine Structure of Weiss Domains on (110) Surfaces of Si-Fe Single Crystals as a Function of Magnetic Field Strength and Field Direction.—R. Kohlhaas & G. Ballmüller. (*Z. angew. Phys.*, March 1961, Vol. 13, No. 3, pp. 131–134.)

538.221 4207

Calculation and Measurement of the Internal Demagnetization Factor.—G. Vogler. (*Ann. Phys., Lpz.*, 16th March 1961, Vol. 7, Nos. 5/6, pp. 268–279.) Magnetic energy and internal demagnetization factor are calculated for various types of distribution of small ferromagnetic particles in a given volume. Results of measurements on rubber-iron mixtures are compared with theoretical findings.

538.221 4208

The Diffusion After-Effect of Permeability of Iron-Nickel Alloys.—D. Gerstner & E. Kneller. (*Z. Metallkde*, June 1961, Vol. 52, No. 6, pp. 426–436.) Investigations were made on the change of permeability in quenched Fe-Ni alloys with 50 to 85% Ni content by weight, at temperatures between 300°C and the Curie point.

538.221: 537.228.4 4209

Magnification of the Magneto-optical Kerr Rotation by Interference.—J. Kranz & A. Schauer. (*Optik, Stuttgart*, April 1961, Vol. 18, No. 4, pp. 186–200.) The rotation can be magnified by means of suitable vapour-deposited films, and this effect is calculated. The method has been used for the observation of Weiss domains [1281 of 1959 (Kranz & Deechsel)].

538.221: 538.23 4210

Investigations of Rotational Hysteresis.—V. Zehler. (*Z. angew. Phys.*, March 1961, Vol. 13, No. 3, pp. 139–141.)

538.221: 538.632 4211

Measurements of Hall Effect in Binary Mixed-Crystal Series of Iron.—W. Jellinghaus & M. P. de Andres. (*Z. angew. Phys.*, March 1961, Vol. 13, No. 3, pp. 121–122.) See also 3681 of October.

538.221: 538.632 4212

Extraordinary-Hall-Effect Measurements on Ni, some Ni Alloys, and Ferrites.—J. M. Lavine. (*Phys. Rev.*, 15th Aug. 1961, Vol. 123, No. 4, pp. 1273–1277.)

538.221: 538.652 4213

The Change in Length of Mixtures of Ferromagnetic and Coercive Materials in a Magnetic Field.—G. Vogler. (*Ann. Phys., Lpz.*, 29th March 1961, Vol. 7, Nos. 7–8, pp. 387–396.) Magnetostrictive effects are calculated and investigated by measurements on a suspension of iron powder in rubber. See also 4207 above.

538.221: 538.652 4214

Volume Magnetostriction in Nickel-Iron Alloys.—Y. Nakamura, T. Nakajima & H. Takaki. (*J. phys. Soc. Japan*, April 1961, Vol. 16, No. 4, pp. 840–841.) Magnetostriction was measured as a function of Ni/Fe ratio in ordered and disordered specimens.

538.221: 538.652: 534.232 4215

Improved Nickel-Base Alloys for Magnetostrictive Transducers.—C. A. Clark. (*J. acoust. Soc. Amer.*, July 1961, Vol. 33, No. 7, pp. 930–933.)

538.221: 539.23 4216

Remanent State in One-Dimensional Micromagnetics.—A. Aharoni. (*Phys. Rev.*, 1st Aug. 1961, Vol. 123, No. 3, pp. 732–736.)

538.221: 539.23 4217

The Theory of Magnetization Reversal in Thin Films.—W. Andrä. (*Z. angew. Phys.*, March 1961, Vol. 13, No. 3, pp. 141–143.) Inhomogeneous reversal processes are considered on the basis of domain theory.

538.221: 539.23 4218

The Magnetic Domain Structure of 'Single-Crystal' Thin Films of Iron.—D. Unangst. (*Ann. Phys., Lpz.*, 16th March 1961, Vol. 7, Nos. 5/6, pp. 280–301.) Bitter pattern technique is used to investigate the domain structure of films of thickness 500–10 000 Å during magnetic reversal and after demagnetization.

538.221: 539.23 4219

The Magnetic Properties of Very Thin Vapour-Deposited Iron Films in a Vacuum and their Change after the Admission of Air.—H. Hoffmann. (*Z. angew. Phys.*, March 1961, Vol. 13, No. 3, pp. 149–151.)

538.221: 539.23 4220

The Curie Temperature of Very Thin Nickel Films.—W. Hellenthal. (*Z. angew. Phys.*, March 1961, Vol. 13, No. 3, pp. 147–149.) Discrepancies in the results of Curie-temperature measurements on thin films by various authors are accounted for by reference to a model based on an investigation of slow magnetization processes (2311 of July) and calculation of the temperature dependence of spontaneous magnetization.

538.221: 539.23 4221

The Influence of Local Fluctuations of Anisotropy on the Magnetic Characteristics of Thin Ni-Fe Films.—S. Middelhoek. (*Z. angew. Phys.*, March 1961, Vol. 13, No. 3, pp. 151–156.)

538.211: 539.23 4222

The Magnetization Reversal of Thin Nickel-Iron Films in the Difficult Direction.—(*Z. angew. Phys.*, March 1961, Vol. 13, No. 3, pp. 157–164.)

Part 1: Electron-Microscope Observations of the Origin of Domains.—E. Fuchs (pp. 157–160).

Part 2: Hysteresis and Domain Behaviour.—E. Fahlbeller (pp. 161–164).

538.221: 539.23 4223

The Temperature Dependence of the Magnetic Properties of Thin Permalloy Films.—A. Segmüller. (*Z. angew. Phys.*, March 1961, Vol. 13, No. 3, pp. 154–157.)

538.221: 539.23: 538.569.4 4224

Ferromagnetic Resonance Absorption of Single-Crystal Thin Films of Nickel.—M. Kuriyama, H. Yamamoto & S. Hosoya. (*J. phys. Soc. Japan*, April 1961, Vol. 16, No. 4, pp. 701–706.) The saturation magnetization, the crystalline anisotropy and the Lande splitting factor were measured for film thicknesses between 100 and 1 000 Å.

538.221: 539.23: 539.61 4225

Measurement of Magnetization at the Surface of Iron-Silicon Single Crystals with the aid of the Magnified Magneto-optical Kerr Effect.—J. Kranz & B. Passon. (*Z. angew. Phys.*, March 1961, Vol. 13, No. 3, pp. 122–124.) See also 3079 of November.

538.221: 539.23: 621.385.833 4226

Electron-Optical Investigation of Domain Boundaries in Thin Ferromagnetic Films.—L. Reimer. (*Z. angew. Phys.*, March 1961, Vol. 13, No. 3, pp. 143–147.) Investigation by means of an electron microscope of Ni and Fe films using the technique described by Fuller & Hale (2005 of 1960).

538.221 : 539.38 **4227**

Deformation of Domain Structures by Stresses.—C. Greiner. (*Z. angew. Phys.*, March 1961, Vol. 13, No. 3, pp. 134–136.) Investigation of the effects of tension and compression on Bloch wall displacement in Ni-Fe (50/50) wire.

538.221 : 621.3.042.2 **4228**

The Dynamic Behaviour of Bloch Walls in Grain-Oriented Laminations.—P. K. Hermann. (*Z. angew. Phys.*, March 1961, Vol. 13, No. 3, pp. 136–139.) An interpretation of the cause of hysteresis effects observed particularly in thin grain-oriented laminations is given.

538.221 : 621.318.124 : 538.569.4 **4229**

Ferrimagnetic Resonance of Single-Crystal Barium Ferrite in the Millimetre Wave Region.—F. F. Y. Wang, K. Ishii & J. B. Y. Tsui. (*J. appl. Phys.*, Aug. 1961, Vol. 32, No. 8, pp. 1621–1622.) Results of measurements at frequencies above 50 Gc/s agree with the theory developed by Weiss & Anderson (3326 of 1955).

538.221 : 621.318.134 **4230**

The Estimation of Domain-Wall Velocity in a 'Square-Loop' Ferrite, and some Observations on the Reversal Process.—J. E. Knowles. (*Proc. phys. Soc.*, 1st Aug. 1961, Vol. 78, No. 500, pp. 233–238.)

538.221 : 621.318.134 **4231**

The Angle Dependence of the Anisotropy Induced in Iron-Nickel Ferrite Single Crystals by a Magnetic Field.—R. Wagner. (*Ann. Phys., Lpz.*, 16th March 1961, Vol. 7, Nos. 5–6, pp. 302–311.) Results of measurements are compared with the theories of other authors.

538.221 : 621.318.134 **4232**

Magnetic Relaxation in Magnetite and in its Solid Solutions with Manganese and Nickel Ferrites.—A. Bragiński & T. Merceron. (*Nature, Lond.*, 26th Aug. 1961, Vol. 191, No. 4791, pp. 898–899.) Relaxation was examined in the systems $Mn_xFe_{3-x}O_{4+y}$ and $Ni_xFe_{3-x}O_{4+y}$ by measuring their permeability disaccommodation. In solid solutions of magnetite with other cubic ferrites, the formation of local configurations of anisotropic space charge is explained by the presence of octahedral sites having trigonal symmetry. Peaks in the disaccommodation spectrum are explained by migration of these vacancies.

538.221 : 621.318.134 **4233**

The Magnetic Spectrum of Ni-Zn Ferrites with Perminvar Loop.—F. Voigt. (*Naturwissenschaften*, April 1961, Vol. 48, No. 7, pp. 215–216.) Report of measurements of the frequency dependence of complex permeability on two types of Ni-Zn ferrite, one containing CoO, with or without annealing in a transverse magnetic field.

538.221 : 621.318.134 **4234**

Magnetic Anomaly in $FeTiO_3$-αFe_2O_3 System by Mössbauer Effect.—S. L. Ruby & G. Shirane. (*Phys. Rev.*, 15th Aug. 1961, Vol. 123, No. 4, pp. 1239–1240.) The anomaly revealed by the Mössbauer measurements is that the ferrimagnetic phase consists of ferrimagnetic clusters surrounded by paramagnetic media.

538.221 : 621.318.134 : 538.569.4 **4235**

Gyromagnetic Resonance of Ferrites and Garnets in the Frequency Range 400–1 200 Mc/s.—J. Deutsch & H. G. Maier. (*Nachrichtentech. Z.*, March 1961, Vol. 14, No. 3, pp. 142–146.) Experimental investigation of nonreciprocal attenuation near gyromagnetic resonance. See also report in *Proc. Inst. Radio Engrs*, Sept. 1961, Vol. 49, No. 9, pp. 1443–1445.

538.221 : 621.318.134 : 538.569.4 **4236**

Pressure Dependence of the Microwave Resonance Properties of some Spinel and Garnet Ferrites.—I. P. Kaminow & R. V. Jones. (*Phys. Rev.*, 15th Aug. 1961, Vol. 123, No. 4, pp. 1122–1129.)

538.221 : 621.318.134 : 538.569.4 **4237**

Nonlinear Damping Losses in YIG.—R. L. Conger. (*J. appl. Phys.*, Aug. 1961, Vol. 32, No. 8, pp. 1525–1527.) A theoretical investigation shows that nonlinear damping causes the microwave ferromagnetic resonance susceptibility to decrease with increasing power.

538.221 : 621.385.833 **4238**

The Origin of Image Contrast in the Display of Ferromagnetic Domains by means of an Illuminating Electron Microscope.—J. Kranz & H. Bialas. (*Optik, Stuttgart*, April 1961, Vol. 18, No. 4, pp. 178–185.) A formula is given which expresses image contrast as a function of (*a*) the gradient of magnetic induction over the specimen, and (*b*) the radius of the image on the screen. Experimental results confirm the conclusions reached.

538.222 : 538.569.4 : 621.375.9 **4239**

On the Theory of Cross-Relaxation in Maser Materials.—M. Hirono. (*J. phys. Soc. Japan*, April 1961, Vol. 16, No. 4, pp. 766–776.) A theoretical study in which the method of moments taking into account the effect of the crystalline electric field.

539.23 : 548.5 : 539.12.04 **4240**

Study of Electron Bombardment of Thin Films.—G. B. Gilbert, T. O. Fochler & C. F. Miller. (*J. appl. Phys.*, Aug. 1961, Vol. 32, No. 8, pp. 1597–1600.) Results obtained using a 35-keV electron beam indicate substantial crystal growth in films of In, Bi and Ge.

539.23 : 621.382.032.27 **4241**

Lead Wire Attachment Technique for Thin-Film Studies.—R. I. George & R. B. McQuistan. (*Rev. sci. Instrum.*, July 1961, Vol. 32, No. 7, pp. 855–856.) Au leads are used on a synthetic sapphire substrate.

621.315.5/.6 : 536.48 : 538.214 **4242**

Magnetic Susceptibility of Materials Commonly Used in the Construction of Cryogenic Apparatus.—G. L. Salinger & J. C. Wheatley. (*Rev. sci. Instrum.*, July 1961, Vol. 32, No. 7, pp. 872–874.)

621.315.5/.6].004.6 **4243**

The Long-Term Behaviour of Materials and Components in Electrical Engineering.—J. Tretter. (*Frequenz*, Feb. 1961, Vol. 15, No. 2, pp. 39–47.) A theoretical interpretation is attempted of after-effect, aging and recovery processes in semiconductor, ferroelectric, ferromagnetic and other materials. Certain laws appear to be followed in the establishment of new equilibrium conditions in materials and components subsequent to the application of energy in the form of heat, light, electricity or mechanical stress.

MATHEMATICS

512.83 : 513.882 **4244**

Computational Problems concerning the Hilbert Matrix.—J. Todd. (*J. Res. nat. Bur. Stand.*, Jan.–March 1961, Vol. 65B, No. 1, pp. 19–22.) The influence of theoretical mathematics and computational experiment on each other is illustrated by a discussion of recent work.

517.522.2 **4245**

A Power Series Expansion of the Master Equation.—N. G. van Kampen. (*Canad. J. Phys.*, April 1961, Vol. 39, No. 4, pp. 551–567.)

MEASUREMENTS AND TEST GEAR

621.3.018.41 (083.74) **4246**

The Standard Frequency of the Federal Post Office.—J. Bastelberger. (*Nachrichtentech. Z.*, Feb. 1961, Vol. 14, No. 2, pp. 72–81.) A standard frequency of 1 kc/s with an accuracy within $\pm 1 \cdot 5$ parts in 10^8 and hourly time pulses are available throughout the whole of West Germany. Details are given of the standard frequency equipment, the comparison system and the distribution network.

621.3.018.41 (083.74) : 621.396.61 **4247**

Effect of External Conditions on the Phase of Radio Signals.—Watt-Carter & Corke. (See 4327.)

621.317.3 : 537.311.33 **4248**

Apparatus for the Measurement of Galvanomagnetic Effects in High-Resistance Semiconductors.—G. Fischer, D. Greig & E. Mooser. (*Rev. sci. Instrum.*, July 1961, Vol. 32, No. 7, pp. 842–846.) The resistivity of samples can be measured if the resistance is in the range 10^{-1}–$10^{12}\Omega$. The Hall coefficient can also be determined provided the charge-carrier mobility of the sample exceeds 1 $cm^2/V.sec$.

621.317.3 : 537.311.33 **4249**

Microwave Measurement of Mobility: Analysis of Apparatus.—S. H. Liu, Y. Nishina & R. H. Good, Jr. (*Rev. sci. Instrum.*, July 1961, Vol. 32, No. 7, pp. 784–789.) A semiconductor sample is mounted

in a bimodal cavity with an applied static magnetic field and the power transfer produced by the Faraday rotation is measured. A formula is derived for the power-transfer ratio as a function of magnetic field, conductivity and mobility of the sample, and the properties of the equipment.

621.317.3: 537.311.33 **4250**

Microwave Measurement of Hall Mobility: Experimental Method.—Y. Nishina & G. C. Danielson. (*Rev. sci. Instrum.*, July 1961, Vol. 32, No. 7, pp. 790–793.) The measurements were made at 9 Gc/s, over the temperature range 30–300°K, and the analysis given by Liu et al. (4249 above) was verified by observations on an *n*-type sample.

621.317.3: 537.311.33 **4251**

Microwave Determination of Semiconductor Carrier Lifetimes.—H. A. Atwater : H. Jacobs. (*Proc. Inst. Radio Engrs*, Sept. 1961, Vol. 49, No. 9, pp. 1440–1442.) Atwater suggests that a microwave power transient will not in general follow the exponential decay of the injected carriers [see 3774 of 1959 (Ramsa et al.)]. Jacobs points out a flaw in the criticism and describes an alternative approach which gives good agreement between theoretical and experimental values [2730 of August (Jacobs et al.)].

621.317.33: 537.311.33 **4252**

An A.C. Silicon Resistivity Meter.—C. C. Allen & W. R. Runyan. (*Rev. sci. Instrum.*, July 1961, Vol. 32, No. 7, pp. 824–828.) A description of a four-point probe resistivity meter, which is direct-reading and covers a resistivity range of 0·01–300 Ω.cm for full-scale deflection.

621.317.34.029.64: 621.372.824 **4253**

Precision Instruments for Coaxial Line Measurements up to 4 Gc/s.—D. Woods. (*Proc. Instn elect. Engrs*, Part B, Sept. 1961, Vol. 108, No. 41, pp. 490–492. Discussion, pp. 493–494.) A program to improve the standardization and measurement of admittance, voltage, power and attenuation is described.

621.317.373 **4254**

Phase Measurement at Audio and High Frequencies.—O. Macek. (*Arch. tech. Messen*, Feb. 1961, No. 301, pp. 35–38.) The methods reviewed include those using c.r. oscilloscopes, ring modulators, and pulse-controlled multivibrators. 31 references.

621.317.44: 538.632 **4255**

Measurements in Inhomogeneous Magnetic Fields by means of the Hall Probe.—P. Menzel. (*Arch. tech. Messen*, April 1961, No. 303, pp. 83–86.) The characteristics and limits of accuracy of Hall-effect devices used for the measurement of magnetic induction are discussed.

621.317.7: 621.372.2.012.11 **4256**

Smith-Diagram Display Unit uses Microwave Phase-Directional Coupler.—S. Tsuchiya. (*Electronics*, 21st July 1961, Vol. 34, No. 29, pp. 80–84.) Microwave impedances can be measured and displayed directly on a c.r. tube.

621.317.733 **4257**

Choosing Transformer Ratio-Arm Bridges.—W. H. P. Leslie. (*Proc. Instn elect. Engrs*, Part B, Sept. 1961, Vol. 108, No. 41, pp. 539–545.) Five bridges are considered in detail and their suitability for the following applications is discussed: (*a*) similar impedances with appreciable capacity to earth from each terminal, (*b*) comparison of low impedances when lead impedance is not negligible and (*c*) measurement by substitution. Karo's circuit (554 of 1959) shows no practical advantage and is based on incorrect analysis.

621.317.74: 621-526 **4258**

An Automatic Electronic Nyquist Plotter.—H. J. Fraser & W. V. P. Reece. (*Proc. Instn elect. Engrs*, Part B, Sept. 1961, Vol. 108, No. 41, pp. 535–538.) An instrument to plot automatically the transfer function of electrical networks or servo systems over the frequency range 0·2–200 c/s.

621.317.74: 621.396.679.4 **4259**

Measurements on a Transmission-Line Ring-Hybrid.—A. J. Hymans. (*Electronic Engng*, Sept. 1961, Vol. 33, No. 403, pp. 578–581.) The design of accessories for measurements in the range 20–30 Mc/s is described including a matched load for 2-kW dissipation.

621.317.761: 538.569.4 **4260**

A Magnetically Tunable Microwave Frequency Meter.—G. H. Thiess. (*Proc. Inst. Radio Engrs*, Sept. 1961, Vol. 49, No. 9, pp. 1439–1440.) A note on a method of frequency measurement based on ferromagnetic resonance [see 1496 of 1956 (Vartanian & Melchor)]. An accuracy within 0·3% can be achieved using single-crystal spheres of Y-Fe garnet.

621.317.794.089.6 **4261**

A Bolometer Mount Efficiency Measurement Technique.—G. F. Engen. (*J. Res. nat. Bur. Stand.*, April–June 1961, Vol. 65C, No. 2, pp. 113–124.) A variation of the impedance measurement method is described which gives increased accuracy and simplifies the operational procedure. It is independent of connector discontinuities and is applicable to matched and unmatched mounts.

OTHER APPLICATIONS OF RADIO AND ELECTRONICS

621-52: 681.142 **4262**

Statistical Design of Linear Discrete-Data Control Systems via the Modified *z*-Transform Method.—J. T. Tou. (*J. Franklin Inst.*, April 1961, Vol. 271, No. 4, pp. 249–262.)

621.317.361.029.42: 612 **4263**

Frequency Measurement of a Strongly Disturbed and Damped Oscillation.—R. Giersiepen. (*Frequenz*, April 1961, Vol. 15, No. 4, pp. 105–111.) The problem considered is that of measuring the natural frequency of the blood circulating system. The use of an electrical equivalent of the circulatory system enables the interference function to be simulated and subtracted from the input function.

621.317.39: 531.71: 537.312.8 **4264**

Design of Magnetoresistance Elements.—D. H. Roberts. (*J. sci. Instrum.*, Aug. 1961, Vol. 38, No. 8, pp. 332–333.) Suggestions are made for improving the performance of an instrument for measuring linear displacement.

621.362: 621.387 **4265**

Optimization of Emission-Limited Thermionic Generators.—A. Schock. (*J. appl. Phys.*, Aug. 1961, Vol. 32, No. 8, pp. 1564–1570.) Equations are derived describing the performance of space-charge-neutralized thermionic convertors. An expression is derived for maximum conversion efficiency in terms of the system parameters.

621.383.5: 621.3.087.9 **4266**

A Fast Numeral Reading Machine.—G. Fougere, J. Preston & R. Farnsworth. (*Electronic Engng*, Sept. 1961, Vol. 33, No. 403, pp. 562–565.) The machine optically reads three-digit numbers printed on plastic tape at a rate of 150 characters/sec.

621.385.833 **4267**

Improved Electron Filter Lens.—J. A. Simpson & L. Marton. (*Rev. sci. Instrum.*, July 1961, Vol. 32, No. 7, pp. 802–803.)

621.385.833 **4268**

First-Order Examination of an Optical System Formed from Four Quadrupolar Electrostatic Lenses.—D. Dhuicq. (*C. R. Acad. Sci., Paris*, 7th Nov. 1960, Vol. 251, No. 19, pp. 1989–1991.)

621.387.4: 621.383.292 **4269**

Semiconductors yield Improved Electron Multiplier.—F. A. White, J. C. Sheffield & W. D. Davis. (*Nucleonics*, Aug. 1961, Vol. 19, No. 8, pp. 58–60.) The magnetic electron multiplier described, which is designed for use as an ion detector, incorporates a parallel-plate dynode system consisting of Au-doped Si.

621.387.4: 621.383.292 **4270**

Resistance-Strip Magnetic Electron Multiplier.—G. W. Goodrich & W. C. Wiley. (*Rev. sci. Instrum.*, July 1961, Vol. 32, No. 7, pp. 846–849.) The multiplier uses a continuous surface of high-resistance semiconductor materials in place of a conventional multielement dynode structure.

621.398: 621-52 **4271**

Analogue and Digital Methods and their Application in Telemetry.—K. Bauer. (*VDI Z.*, 21st Aug. 1961, Vol. 103, No. 24, pp. 1209–1217.) Examples of circuits and equipment are given and their operation is described with particular regard to the presentation in digital form of process control measurements.

621.56/.57: 537.322.15 **4272**

Frigistors—Thermocouples of Semiconductor Material for use as Cooling Elements and Heat Pumps.—W. Dörr.

(*Elektronische Rundschau*, March 1961, Vol. 15, No. 3, pp. 107–111.) Various patterns of commercial-type Bi-Te junctions using the Peltier effect are described.

PROPAGATION OF WAVES

621.391.812.62 **4273**

Effect of Multiple Atmospheric Inversions on Tropospheric Radio Propagation.—F. H. Northover. (*J. Res. nat. Bur. Stand.*, July/Aug. 1961, Vol. 65D, No. 4, pp. 385–392.) An earlier theory (1409 of 1952) for a single elevated inversion layer is extended to cover the case of multiple layers. Under certain conditions, several weak high-level inversions can produce a similar effect to a single strong inversion.

621.391.812.62 **4274**

Smooth-Earth Diffraction Calculations for Horizontal Polarization.—L. E. Vogler. (*J. Res. nat. Bur. Stand.*, July/Aug. 1961, Vol. 65D, No. 4, pp. 397–399.) A simplified method of calculating attenuation in the 'far diffraction region' is described, and an improved criterion is given for determining the ranges of validity of the method.

621.391.812.63 **4275**

Effects of Equatorial Spread-*F* Irregularities on C.W. Transmissions.—M. S. V. G. Rao & B. R. Rao. (*Canad. J. Phys.*, April 1961, Vol. 39, No. 4, pp. 596–603.) A c.w. signal on 11·7 Mc/s was recorded to study the fading rate during spread-*F* conditions and the horizontal extent of spread-*F* patches affecting the 1 300-km path from Colombo to Waltair. The fading rate increased from 10·7 cycles/minute (no spread-*F*) to about 40 cycles/minute (severe spread-*F*) with more rapid flutter also present. Patches of more than 650 km extent in the N-S direction apparently occur over this path.

621.391.812.63 **4276**

Observations of Unusual Low-Frequency Propagation made on 12th November 1960.—J. S. Belrose & D. B. Ross. (*Canad. J. Phys.*, April 1961, Vol. 39, No. 4, pp. 609–614.) Amplitude and phase measurements were made near 80 kc/s in northern Canada.

621.391.812.63 : 551.510.535 **4277**

On the Validity of some Approximations to the Appleton-Hartree Formula.—K. Davies & G. A. M. King. (*J. Res. nat. Bur. Stand.*, July/Aug. 1961, Vol. 65D, No. 4, pp. 323–332.) Various approximations for the refractive index are compared with values computed from the complete formula, for various latitudes and a frequency of 2·0 Mc/s. Some approximations become very poor only a short distance from where they are exact. Formulae are given that yield sufficiently accurate values for all geomagnetic latitudes. Certain approximations to the group refractive indices are also considered.

621.391.812.63 : 551.510.535 **4278**

Investigation of Ionospheric Absorption on 5·65 Mc/s at Waltair.—K. V. V. Ramana & B. R. Rao. (*J. atmos. terr. Phys.*, Sept. 1961, Vol. 22, No. 1, pp. 1–11.) Measurements were made during the I.G.Y. and I.G.C. periods and the diurnal and seasonal variations of absorption were studied. The simple relation $\log \rho = a f^{-2} \cos^n \chi$ is only approximate and the observations can be better fitted to an expression depending on Jaegers' function (3252 of 1947).

621.391.812.63 : 551.510.535 **4279**

The Fading of Radio Waves Reflected Vertically from the Ionosphere during Magnetic Storms.—Forde. (See 4133.)

621.391.812.63.029.4 : 621.396.67 **4280**

On the Possibility of Rejecting Certain Modes in V.L.F. Propagation.—J. R. Wait. (*Proc. Inst. Radio Engrs*, Sept. 1961, Vol. 49, No. 9, pp. 1429–1430.) An analysis of the second-order mode and its dependence on the structure of the transmitting aerial.

621.391.814.2.029.4 : .5 **4281**

On the Theory of Mixed-Path Ground-Wave Propagation on a Spherical Earth.—J. R. Wait. (*J. Res. nat. Bur. Stand.*, July/Aug. 1961, Vol. 65D, No. 4, pp. 401–410.) "The problem formulated concerns the mutual impedance between two vertical dipole antennas *A* and *B* located near the surface of a spherical smooth earth. The path between *A* and *B* is made up of a number of homogeneous segments where the surface impedance is constant. Various formulas are developed, for two- and three-section paths, which are suitable for computation. Certain limiting cases are discussed and where possible a physical interpretation of the results is given. Comparisons with previous work are made."

621.391.814.2.029.53 **4282**

A Few Observations of the Perturbations in the Phase of the Low-Frequency Ground Wave.—J. M. Ross & J. E. Kirch. (*J. Res. nat. Bur. Stand.*, July/Aug. 1961, Vol. 65D, No. 4, pp. 393–396.) "The effects of anomaly-producing terrain features on the phase of the low-frequency ground wave were measured in a nearly idealized environment to confirm theoretical predictions. Results for an isolated butte gave good correlation with the theoretical model. In most cases the mean value of the phase perturbation approached zero."

RECEPTION

621.376.23 : 523.164 **4283**

Digital Methods for the Extraction of Phase and Amplitude Information from a Modulated Signal.—R. S. Lawrence, J. L. Jespersen & R. C. Lamb. (*J. Res. nat. Bur. Stand.*, July/Aug. 1961, Vol. 65D, No. 4, pp. 351–356.) "A zero-crossing method, a filter method and a statistical approach intended for the analysis of radio-star scintillations are described. They may be applied to other types of modulated signal.

621.391.81 **4284**

Correlation Measurements on Frequency Diversity in the Short-Wave Range.—J. Grosskopf, G. Heinzelmann & K. Vogt. (*Nachrichtentech. Z.*, March 1961, Vol. 14, No. 3, pp. 124–128.) Report on investigations of frequency diversity reception over the path Tokyo–Frankfurt (Main) using s.s.b. transmitters on 19·79 and 14·73 Mc/s, the frequency diversity in each case being obtained by a.f. modulation of the transmitter. A reduction of the frequency spacing normally used in frequency-diversity systems appears to be possible. For investigations of space-diversity reception see 953 of 1959 (Grosskopf et al.).

621.391.812.63 **4285**

Some Experiments on the Reception of Long-wave Waves.—M. Marcianni. (*Alta Frequenza*, April 1961, Vol. 30, No. 4, pp. 293–295.) Report on reception tests at 272 kc/s to investigate phase distortion due to ionospheric propagation of amplitude-modulated signals. Typical oscillograms are reproduced. For English version see *ibid.*, July 1961, Vol. 30, No. 7, pp. 543–548.

621.391.82 : 551.507.362 **4286**

Analysis and Prediction of Radio Signal Interference Effects due to Ionized Layer around a Re-entry Vehicle.—M. C. Taylor. (*Planet. Space Sci.*, July 1961, Vol. 7, pp. 206–209.) The problem of transmitting c.w. waves through the thermally ionized layer of gases in the shock layer round a hypersonic missile is considered.

621.391.823 : 621.317.3 (083.74) **4287**

I.E.E. Standards on Radio Interference: Methods of Measurement of Conducted Interference Output to the Power Line from F.M. and Television Broadcast Receivers in the Range of 500 kc/s to 25 Mc/s, 1961.—(*Proc. Inst. Radio Engrs*, Sept. 1961, Vol. 49, No. 9, pp. 1390–1402.) Standard 61 I.E.E.-27.S1.

621.396.62 : 534.76 **4288**

Multiplex Adapters for Compatible F.M. Stereo Reception.—L. Solomon. (*Electronics*, 18th Aug. 1961, Vol. 34, No. 33, pp. 45–47.) A summary of methods and design principles.

621.396.62 : 621.396.71 **4289**

New Short-Wave Large-Station Receiving Equipment for Telegraphy and Telephony.—D. Leopold, P. Schmelz & H. Wirth. (*Frequenz*, Feb. 1961, Vol. 15, No. 2, pp. 49–55.) Equipment for s.s.b. and telegraphy diversity operation is described.

621.396.62 : 621.396.71 : 621.396.62 **4290**

Telegraphy Equipment in the New Short-Wave Receiver for Large Stations.—H. Meixner. (*Frequenz*, Feb. 1961, Vol. 15, No. 2, pp. 56–58.) See 4289 above.

621.396.621.54 : 621.391.82 **4291**

The Discrimination of the Image Response in a Superheterodyne with regard to Noise-Factor Measurements.—M. Pastelli. (*Proc. Inst. Radio Engrs*, Sept. 1961, Vol. 49, No. 9, p. 1405.)

621.396.668 : 621.391.812.63 **4292**

Elimination of Ionospheric Refraction Effects.—J. M. Brito-Infante. (*Proc.*

Inst. Radio Engrs, Sept. 1961, Vol. 49, No. 9, pp. 1451–1452.) If radio signals from a mobile transmitter are received on several different frequencies, the frequency shift due to ionospheric refraction can be eliminated. The analytical procedure for using this principle in practice is given.

STATIONS AND COMMUNICATION SYSTEMS

621.376.3 **6705**

Power in a Frequency-Modulated Wave.—R. C. Medhurst. (*Electron. Technol.*, Oct. 1961, Vol. 38, No. 10, pp. 370–378.) The time variation of the mean power in a sampling period is calculated for the general case where there is no specific relation between modulation frequency and carrier frequency or sampling period.

621.39 (06) **6706**

Broadband Telecommunication Systems.—A. H. Kaye, P. D. Lihoreau, J. F. Smart, P. H. Richards, J. R. Wakelin & J. C. Wilson. (*J. Instn Engrs, Aust.*, June 1961, Vol. 33, No. 6, pp. 153–176.) A collection of six papers on operation and proposed Australian communication systems.

621.391 **6707**

Recommended Gates and Delay for Amplitude-Sampled White Noise.—D. A. Bochkis. (*Proc. Inst. Radio Engrs*, Sept. 1961, Vol. 49, No. 9, p. 1436.) An expression is derived for the mean square reconstruction error.

621.391: 621.376.3 **6708**

Instantaneous Pulse Companding in Time-Modulated Transmission Systems.—W. Gibson. (*Radio Electron. Engr.*, March 1961, Vol. 21, No. 3, pp. 109–114.) The application of a companding method to pulse-modulated systems, and the resultant advantages, are discussed.

621.396.43: 523.3 **6709**

Long-Distance Communication via the Moon.—P. A. Wehner. (*J. Brit. Instn Radio Engrs*, Sept. 1961, Vol. 22, No. 3, pp. 253–264.) Optimum frequency, type of modulation, aerial size and other requirements for economic operation of a circuit via the moon are considered. Experiments at 200 Mc/s using a 1-kW transmitter and the Jodrell Bank radio telescope are described.

621.396.43: 523.3 **6710**

A Study of U.H.F. Space Communications through an Ionosphere using the Moon as a Reflector.—R. P. Ingalls, J. C. James & W. L. Stone. (*Planet. Space Sci.*, July 1961, Vol. 7, pp. 172–181.) Signals at 440 Mc/s from a transmitter at College, Alaska, to the aerial one were reflected from the moon and received at two stations in the mid-latitude zone. The decrease of received power was noticed when the propagated signal passed through an auroral disturbance but the observed fading rate increased and the observed polarization angle fluctuated rapidly.

621.396.43: 523.5 **6711**

Propagation of Meteor-Burst Signals during the Polar Disturbance of November 12–16, 1960.—L. A. Maynard. (*Canad. J. Phys.*, April 1961, Vol. 39, No. 4, pp. 629–630.) It is concluded that the fall in signal strength was due to absorption below the meteoric region at heights of 80–100 km.

621.396.43: 537.567.362.2 **6712**

Radio Communication by means of Satellites.—C. C. Cutler. (*Planet. Space Sci.*, July 1961, Vol. 7, pp. 250–275.) An examination is made of the difficulties of long-distance radio communication by satellite, comparing the simplicity of a passive repeater with a very low reflected signal to the complex power and orientation problems of a solar-powered transmitter-receiver with much narrower bandwidth.

621.396.43: 551.507.362.2 **6713**

Satellite-Suggested Communication at 25 Megacycles.—R. Sodin. (*Proc. Inst. Radio Engrs*, Sept. 1961, Vol. 49, No. 9, pp. 1415–1436.) A group of transmitters and receivers operated near New York in 1958–1960. Signal bursts which occurred during 6-min periods before, during and after satellite passes were recorded. 29 bursts occurred during the central periods as compared with 1 before and 0 after these periods. The statistical probability that the bursts are associated with the passes is very high.

621.396.43: 551.507.362.2 **6714**

The Advantages of Accurate Satellite Position and Station Keeping in Communication Satellite Orbits.—W. F. Hilton & R. Stewart. (*J. Brit. Instn Radio Engrs*, Sept. 1961, Vol. 22, No. 3, pp. 193–202.) Satellites using high-gain aerials requiring stabilizing equipment in the passive and controlled satellites using higher transmitter power are compared. Spin stabilization is examined and random and station-keeping satellites are discussed.

621.396.43: 551.507.362.2 **6715**

A Proposal for an Active Communication Satellite System based on Inclined Elliptic Orbits.—R. Bass & J. R. Millburn. (*J. Brit. Instn Radio Engrs*, Sept. 1961, Vol. 22, No. 3, pp. 209–221.) Four satellites in a 63-degree elliptical orbit would give a good service to the northern hemisphere. The design for a 1 000-telephone-channel satellite having a radiated power of 12 W at the optimum frequency of 2 Gc/s is given.

621.396.43: 551.507.362.2 **6716**

Some International Aspects of Satellite Communication Systems Planning.—C. F. Booth. (*J. Brit. Instn Radio Engrs*, Sept. 1961, Vol. 22, No. 3, pp. 227–229.) The allocation of frequency bands, methods of minimizing interference with other services and the type of modulation and bandwidth characteristics require international agreement.

621.396.43: 551.507.362.2 **6717**
—621.371.9: 538.569.4

The Moon and its Applications to Satellite Communication Systems.—Hinrichsen. (See 6017.)

621.396.43: 621.396.677 **6718**

Antenna-Beam Configurations in Scatter Communications.—Waterman. (See 6009.)

621.396.43: 629.19 **6719**

Long-Range Radio Communication by Satellite Microwave Dipoles.—(*Nature, Lond.*, 23rd Sept. 1961, Vol. 191, No. 4795, pp. 1237–1238.) A note on the Space Science Board's general recommendations on the West Ford project.

621.396.65 **6720**

The Development of the A.T.E. Radio-Link System.—F. Angers. (*E.B.U. Rev.*, April 1961, No. 66-A, pp. 61–68.) Fundamental design principles are discussed covering technical and economic criteria.

621.396.712: 621.316.9 **6721**

The Lightning Protection of Broadcasting Stations in Norwegian Mountains.—H. Christensen. (*E.B.U. Rev.*, April 1961, No. 66-A, pp. 50–60.) Protective measures are summarized and statistical data of station breakdowns in relation to thunderstorm occurrence are given.

621.396.74: 681.84:087.7 **6722**

Review of the Main Proposals for the Simultaneous Transmission of Stereophony.—R. Wilhelm. (*Nachrichtentech. Z.*, Munich, March 1961, Vol. 14, No. 3, pp. 129–141.) International proposals are summarized and compared. 38 references.

621.396.946 **6723**

The Possibility of Reception of Communications from Extraterrestrial Transmitting Systems.—M. V. Ayzenberg & G. Belorusov. (*Radiotekhnika i Elektronika*, Feb. 1961, Vol. 31, No. 1, pp. 1–5.) The feasibility and transmitter power requirements of a communication system with a planet at a distance of 100 light-years are estimated on the basis of information theory and galactic noise data. See e.g. 23003 of 1960A (Brasovskii).

SUBSIDIARY APPARATUS

621-526: 522.6 **6724**

Servo System Design for Ballistic-Camera Star Trackers.—W. J. Wichman & M. M. Benhaim. (*Electronics*, 1st Sept. 1961, Vol. 34, No. 35, pp. 45–46.) The telescope-pointing equipment can operate over a dynamic light range of 1 000 000 : 1, the average pointing error being within 3 seconds of arc.

621.3.087.4: 621.395.625.3 **6725**

Magnetooptical Readout of Magnetic Recordings.—T. Lentz & J. Wyatt. (*Electronics*, 1st Sept. 1961, Vol. 34, No. 35, pp. 36–39.) This technique is based on the rotation of the plane of polarization of a light beam reflected from a magnetized surface.

621.311.69: 629.19 **6726**

Power Supplies for Space Vehicles.—K. E. V. Willis. (*J. Brit. Instn Radio Engrs*,

Sept. 1961, Vol. 22, No. 3, pp. 179–188.) Available unconventional power sources are reviewed in the light of possible future requirements.

621.314.63 **4315**

Silicon Power Rectifiers.—A. J. Blundell, A. E. Garside, R. G. Hibberd & I. Williams. (*Proc. Instn elect. Engrs*, Part A, Aug. 1961, Vol. 108, No. 40, pp. 273–288. Discussion, pp. 288–294.) The processes involved in preparing single-crystal Si are outlined and details of design, production techniques and characteristics of Si rectifiers are given.

TELEVISION AND PHOTOTELEGRAPHY

621.397.13: 389.6 **4316**

Standard Conversion of Television Signals with Different Vertical Scanning Frequency.—E. Sennheim. (*Radio Mentor*, March 1961, Vol. 27, No. 3, pp. 184–188.) Problems arising in the reproduction of recorded television signals of differing field frequency are discussed. An automatic control system is described for compensating the fluctuations produced by the conversion process.

621.397.132 **4317**

Circuit Technique of Demodulators for Colour Television Signals according to the N.T.S.C. Method.—F. Jaeschke. (*Arch. elekt. Übertragung*, April 1961, Vol. 15, No. 4, pp. 187–199.) Design problems peculiar to colour television engineering are discussed and several types of demodulator circuit are considered. For the design of a modulator see 2762 of 1959.

621.397.331.21 **4318**

Investigations on Image-Iconoscope Camera Tubes by means of Special Test Equipment.—A. Kaufmann. (*Rundfunktech. Mitt.*, Feb. 1961, Vol. 5, No. 1, pp. 27–34.) The test equipment is described and a test specification meeting practical studio requirements is proposed. Tests were made on different types of tube to determine the dependence of tube performance on parameters such as temperature, beam current and collector voltage.

621.397.331.22: 621.397.61 **4319**

The Simplification of the Operation of Image Orthicons.—T. Meyer & G. E. Partington. (*Rundfunktech. Mitt.*, Feb. 1961, Vol. 5, No. 1, pp. 1–7.) Description of the principal features of the 4½-in. image orthicon and its applications. See also 1658 of May (Partington).

621.397.331.222 **4320**

Operation of Vidicons in Unusual Environmental Conditions.—G. A. Robinson. (*J. Soc. Mot. Pict. Telev. Engrs*, April 1961, Vol. 70, No. 4, pp. 264–266.) The effects of temperature, high pressure and nuclear radiation on vidicon tubes were examined.

621.397.334: 621.396.621 **4321**

Progress Report on the Development of a Photoelectric Beam-Index Colour-Television Tube and System.—R. Graham, J. W. H. Justice & J. K. Oxenham. (*Proc. Instn elect. Engrs*, Part B, Sept. 1961, Vol. 108, No. 41, pp. 511–520. Discussion, pp. 520–523.) The principle of operation of the Zebra system is described and methods of overcoming some of the basic problems of indexing are outlined. Comparisons are drawn between index and other colour-television displays. See also 1004 of March (Macwhirter).

621.397.6: 535.376 **4322**

The Application of Monochromatocorrection in Television Technique.—L. Jung. (*Tech. Mitt. RRF, Berlin*, March 1961, Vol. 5, No. 1, pp. 25–36.) Present-day developments in the design of image intensifiers, image display and storage devices are reviewed.

621.397.61: 621.376.2 **4323**

The Modulation of Television Transmitters in the Intermediate-Frequency Range.—P. Kluge. (*Rundfunktech. Mitt.*, April 1961, Vol. 5, No. 2, pp. 79–87.) The advantages of using low-level modulation at intermediate frequency are reviewed, with particular reference to results obtained with C.C.I.R. modified N.T.S.C. colour-television signals. See also 1035 of 1960.

621.397.7-182.3 **4324**

Mobile Eurovision Installation of Österreichischer Rundfunk [Austrian Broadcasting System].—F. Brunner. (*Rundfunktech. Mitt.*, Feb. 1961, Vol. 5, No. 1, pp. 23–26.) The installation described comprises all the equipment necessary for Eurovision transmissions apart from that carried by the television outside-broadcast vehicle.

621.397.7-182.3 **4325**

The Television Outside-Broadcast Vehicles for Southern Switzerland.—H. Probst. (*Tech. Mitt. PTT*, March 1961, Vol. 39, No. 3, pp. 71–87. In German and Italian.) Detailed description of the mobile studio installation which is housed in two vehicles.

621.397.74 **4326**

Video Cross-Bar Distributor.—H. H. Freytag. (*Rundfunktech. Mitt.*, April 1961, Vol. 5, No. 2, pp. 61–65.) Description of a distribution installation for television networks which is remotely controlled and incorporates transistor amplifiers.

TRANSMISSION

621.396.61: 621.3.018.41 (083.74) **4327**

Effect of External Conditions on the Phase of Radio Signals.—D. E. Watt-Carter & R. L. Corke. (*Nature, Lond.*, 23rd Sept. 1961, Vol. 191, No. 4795, p. 1286.) Phase errors in the 16-kc/s transmission from Rugby are due to (a) aerial detuning caused by changing weather and aerial ears, and (b) mechanical fluctuations of the tuning inductor and transient thermal and electrical effects in the amplifiers when the transmitter is keyed. Only those due to (a) would be likely to be observed at a distance.

VALVES AND THERMIONICS

621.382.083.78: **4328**

International Steps of Standardization of Semiconductor Components.—M. Fuhrer. (*Radio Tech.*, Feb. 1961, Vol. 11, No. 2, pp. 50–55.) Standards of terms and symbols are compared and standardized measuring circuits are given.

621.382.23 **4329**

Interpretation of the Tunnel-Diode Characteristic from its Variation with Temperature.—G. Wunsel. (*Z. Naturf.*, April 1961, Vol. 16a, No. 4, pp. 435–440.) The characteristics of Ge and GaAs tunnel diodes were investigated in the temperature range 100–400 K.

621.382.23 **4330**

Diode Reverse Characteristics at Low Temperatures.—A. S. Clarkson. (*Proc. Inst. Radio Engrs*, Sept. 1961, Vol. 49, No. 9, pp. 1425–1426.) The characteristics of inductance and negative resistance have been observed in a junction diode at temperatures below 78°K. Possible explanations are advanced.

621.382.23 **4331**

Reverse Characteristics of Low-Lifetime Germanium Diodes.—A. Blicher & I. H. Kalish. (*Proc. Inst. Radio Engrs*, Sept. 1961, Vol. 49, No. 9, p. 1427.) Measurements are described which confirm the theory that carrier generation in the depletion region is responsible for the nonsaturable reverse characteristics of Ge *p-n* junctions.

621.382.23 **4332**

The Tunnel Diode: Physical Basis, Manufacture and Applications.—H. J. Hartmann, M. Michelitsch & W. Steinhäuser. (*Arch. elekt. Übertragung*, March 1961, Vol. 15, No. 3, pp. 125–144.) A summary giving physical principles and circuitry. 30 references.

621.382.23 **4333**

Temperature Dependence of the Peak Current of Germanium Tunnel Diodes.—A. Blicher, R. M. Minton & R. Glicksman. (*Proc. Inst. Radio Engrs*, Sept. 1961, Vol. 49, No. 9, pp. 1428–1429.) The temperature dependence was investigated as a function of carrier concentration.

621.382.23 **4334**

The Effect of Nonsymmetrical Doping on Tunnel Diodes.—F. D. Shepherd & A. C. Yang. (*Proc. Inst. Radio Engrs*, Sept. 1961, Vol. 49, No. 9, pp. 1435–1436.) Esaki's model (1784 of 1958) is used to

explain the *IV* characteristics of the tunnel diode. The properties are shown to be quite dependent upon the degeneracy ratio and the cutoff voltage.

621.382.29: 621.372.44 4335

Negative-Resistance Diode Amplifier Theory.—A. P. Schmidt, Jr. (*Microwave J.*, 5th Aug. 1961, Vol. 10, No. 10, pp. 40–46.) Theory and applications of a bonded diode with current-controlled negative resistance are discussed.

621.382.23: 621.372.44 4336

The Negative-Resistance in Junction Diodes.—E. Mehler. (*Proc. Inst. Radio Engrs*, Sept. 1961, Vol. 49, No. 9, pp. 1427–1428.) Negative-resistance effects are discussed which could explain the anomalous *C–V* characteristics of variable-capacitance diodes used in parametric devices [see e.g. 2888 of August (Mehler)].

621.382.233: 621.318.57 4337

The Silicon Four-Layer Diode and its Application as an Electronic Switch.—H. Kalter & G. Wiesenack. (*Philips Tech. Rdsch.*, Feb. 1961, Vol. 22, No. 8, pp. 225–231.) The principle of operation and several practical switching circuits are described.

621.382.223: 621.318.57 4338

Minimum Time for Turn-Off in Four-Layer Diodes.—M. A. Melchior. (*Proc. Inst. Radio Engrs*, Sept. 1961, Vol. 49, No. 9, p. 1428.) An approximate simple form for the minimum time τ_0 required to turn off a four-layer diode is derived and a method of plotting τ_0 against the device constants is demonstrated.

621.382.3 4339

'Spread' in Transistor Samples.—R. Paul. (*NachrTech.*, Feb. 1961, Vol. 11, No. 2, pp. 56–65.) Investigation of the causes of deviation in the characteristics of individual mass-produced transistors.

621.382.3 4340

Problems of Lifetime and 'Spread' of Transistors.—G. Fassbender. (*NachrTech.*, Feb. 1961, Vol. 11, No. 2, pp. 66–71.) Ways of improving transistor quality and reliability are discussed with reference to curves giving the spread in the characteristics of manufactured components.

621.382.3 4341

The Recombination of Injected Charge Carriers in Transistors.—H. U. Harten. (*Elektronische Rundschau*, March 1961, Vol. 15, No. 3, pp. 111–116.) The significance of the effect and means of reducing it are discussed.

621.382.3 4342

Some Advantages of Silicon Transistors in Circuit Design.—M. K. McPhun. (*Proc. Instn elect. Engrs*, Part B, Sept. 1961, Vol. 108, No. 41, pp. 570–575.) The performance of Si transistors is compared with that of Ge devices from the viewpoint of the circuit designer.

621.382.3: 621.375.4 4343

Stabilization of the D.C. Operating Point of Transistors.—A. E. Bachmann. (*Tech. Mitt. PTT*, March 1961, Vol. 39, No. 3, pp. 88–99.) Account is taken of the effect of emitter-base voltage changes on stability. Tables are included which give the stability factor of two- and three-stage direct-coupled transistor amplifier circuits.

621.382.3: 621.375.18: 621.372.44 4344

Parametric amplification with Transistors.—Rodwin. (*See* 4066.)

621.382.3.018.6: 518.28 4345

The Improvement of the Quality of Life Tests in the Manufacture of Transistors.—C. Villalba. (*Arch. elekt. Übertragung*, April 1961, Vol. 15, No. 4, pp. 161–166.) The problem of storing and evaluating the data obtained from reliability tests is considered. The limitation and subdivision of the information range on the basis of statistical principles are considered, and a system of symbols is given for the various types of life-test curve obtained. The evaluation of life-test results as discussed could be carried out automatically.

621.382.32 4346

D.C. Characteristic of the Unipolar Transistor taking account of Low Impedances.—A. H. Frei. (*Arch. elekt. Übertragung*, April 1961, Vol. 15, No. 4, pp. 161–165.) A formula is derived for the d.c. characteristics of the unipolar field-effect transistor (tecnetron) assuming smooth distribution of the space-charge field in the active channel. Good agreement between theoretical and measured results is obtained.

621.382.32: 539.12.04 4347

Electron-Radiation Damage in Unipolar Transistor Devices.—B. A. Kulp, J. P. Jones & A. F. Vetter. (*Proc. Inst. Radio Engrs*, Sept. 1961, Vol. 49, No. 9, pp. 1437–1438.) The characteristics after various degrees of electron bombardment are shown. Some recovery could be obtained by annealing.

621.382.333 4348

The Thermal Behaviour of Transistors with Nonstationary Collector Dissipation.—H. Reimann. (*Nachrichtentech. Z.*, Feb. 1961, Vol. 14, No. 2, pp. 69–72.) Theoretical investigation of conditions in a transistor with fluctuating load, on the basis of a rough approximation.

621.382.333 4349

Noise Investigations on Silicon Transistors.—B. Kurz. (*Bull. schweiz. elektrotech. Ver.*, 20th May 1961, Vol. 52, No. 10, pp. 369–377.) Results of measurements on Si alloy-junction transistors agree satisfactorily with the theoretical noise factors obtained.

621.382.333.015.5 4350

Voltage Breakdown of Transistors.—S. C. Ryder-Smith. (*Electronic Technol.*, Oct. 1961, Vol. 38, No. 10, pp. 348–356.) The mechanisms of avalanche and punch-through breakdown are explained and the effects of external circuit elements on the breakdown voltages are discussed. The application of voltage ratings to practical circuits is considered with a view to protecting the transistors without being unduly restrictive.

621.382.333.33: 621.318.57 4351

Temperature Effects on Go-to-Switch-ing Transistors.—E. D. Hunteman, J. A. Myslinski, N. Almeida, H. Hurwitz & E. L. Schrock. (*Proc. Inst. Radio Engrs*, Sept. 1961, Vol. 49, No. 9, p. 1440.) The current transfer ratio increases slightly at high temperatures and for use more at low temperatures.

621.383.292 4352

The Temperature Profile of Photomultipliers.—H. C. Ingrao & J. M. Pascoe. (*Rev. sci. Instrum.*, July 1961, Vol. 32, No. 7, pp. 806–807.)

621.385.032.213.13 4353

Improvement in Oxide-Cathode Stability by Controlled Electrolysis.—A. Sandon. (*Le Vide*, May–June 1961, Vol. 16, No. 93, pp. 79–90. In French and English.)

621.385.032.213.13 4354

Effect of Ultraviolet Irradiation on the Electrical Conductivity of Cathodes Coated with Barium Oxide.—C. H. B. Mee. (*Nature, Lond.*, 30th Sept. 1961, Vol. 191, No. 4796, pp. 1303–1304.) Ultraviolet irradiation increased the room-temperature dark conductivity of a BaO-coated cathode by a factor of about two at 370 K after which the effect decreased with increase of temperature and disappeared when 530 K was exceeded. After cooling, the cathode was shown to have returned to its original state.

621.385.032.213.62 4355

The Lifetime of a Tungsten Heater Filament under Different Operating Conditions.—B. Berkel. (*Arch. Elektrotech.*, 15th Feb. 1961, Vol. 46, No. 1, pp. 59–63.) The investigations are concerned with the heater filaments of saturated diodes used in current or voltage stabilizers. The operating conditions considered are (*a*) constant heater voltage, (*b*) constant heater current, (*c*) constant filament temperature, and (*d*) constant anode current. Formulae are given for calculating the stability of voltage or current regulators controlled by such diodes.

621.385.032.269.1: 621.391.822 4356

The Finite-Beam Space-Charge-Limited Diode as a Noise Transducer.—R. A. McFarlane. (*Canad. J. Phys.*, April 1961, Vol. 39, No. 4, pp. 568–578.) A method is presented for calculating the noise properties of a cylindrical electron beam from a space-charge-limited diode electron gun. The multivelocity character of the beam is considered and correction is made for finite beam diameter. The ratio of anode noise current to full shot noise is found to depend on $\omega^{1/2}/V_{0a}$, where ω is the frequency and V_{0a} the anode voltage.

621.385.032.269.1: 621.391.822 4357

Microwave Noise in Accelerated Electron Streams.—R. A. McFarlane. (*Canad. J. Phys.*, April 1961, Vol. 39, No. 4, pp. 579–587.) Noise current fluctuations on the beam from a space-charge-limited diode electron gun were measured at 1 400, 4 250 and 9 520 Mc/s. The measurements are compared with a theory

which takes account of the finite beam diameter and the velocity distribution of the electrons.

621.385.3.029.6 **4358**

New Method of Calculating the Admittance of Disk-Seal Triodes under Small-Signal Conditions.—I. Vágó & M. Uzsoky. (*Period polyt. Bp., Elect. Engng*, 1961, Vol. 5, No. 2, pp. 107–127. In German.) The solution is obtained by a variational method and given in operational form applicable to any type of voltage function.

621.385.5.032.265: 621.376.23 **4359**

Synchronous Detector using the 7360 Beam-Deflection Tube.—A. Sobel. (*Rev. sci. Instrum.*, July 1961, Vol. 32, No. 7, pp. 867–868.) The advantages of the detector include cancellation of drift due to changes in cathode emission, and the elimination of balancing transformers or phase inverters.

621.385.6: 621.372.8 **4360**

On the Theory of a Microwave Electron Device with Interaction in the Transverse Direction.—L. N. Loshakov. (*Radiotekhnika i Elektronika*, Sept. 1960, Vol. 5, No. 9, pp. 1443–1457.) Results of a preliminary theoretical investigation of an electron-beam/waveguide system in which the beam moves in a direction perpendicular to the power flow.

621.385.62.072.6 **4361**

An Arrangement for the Frequency Stabilization of a Klystron Oscillator.—E. Pietzsch. (*Tech. Mitt. BRF, Berlin*, March 1961, Vol. 5, No. 1, pp. 37–41.) A mechanical wobbulator system and discriminator amplifier for stabilization at 4 Gc/s are described.

621.385.623.5: 621.376.3 **4362**

Frequency Modulation of a Reflex Klystron with Minimum Incidental Amplitude Modulation.—W. R. Day, Jr. (*Proc. Inst. Radio Engrs*, Sept. 1961, Vol. 49, No. 9, pp. 1449–1450.)

621.385.624 **4363**

Finite-Gap Klystrons.—L. Solymar. (*Electronic Technol.*, Oct. 1961, Vol. 38, No. 10, pp. 373–377.) The amplitudes of the fundamental and harmonic components of current are calculated using a large-signal ballistic theory. For large signals, the dependence on gap width is altered but gap admittance is invariant.

621.385.63 **4364**

Contribution to the Theory of Minimum Noise Figure of Low-Noise Travelling-Wave Tubes.—K. B. Niclas. (*Arch. elekt. Übertragung*, Feb. 1961, Vol. 15, No. 2, pp. 101–107.) Conditions for obtaining the minimum noise figure are formulated; they are of a more general character than those given by Bloom & Peter (3402 of 1954). A method of measuring noise parameters is described with an example of its application at 3 Gc/s.

621.385.63: 621.375.9: 621.372.44 **4365**

Microwave Amplification in Electrostatic Ring Structures.—J. C. Bass. (*Proc. Inst. Radio Engrs*, Sept. 1961, Vol. 49, No. 9, pp. 1424–1425.) Amplification by means of axially symmetric e.s. rings with an axial magnetic field is described and experimental results are given.

621.385.63: 621.396.65 **4366**

Travelling-Wave Amplifiers.—T. Berceli. (*Period. polyt., Bp., Elect. Engng*, 1961, Vol. 5, No. 1, pp. 75–91. In German.) Travelling-wave amplifier equipment for the final stage of a radio-link installation is described. A design method for the helix coupling system is given which takes account of the effect of screening.

621.385.632 **4367**

Experimental Study of a Backward-Wave Tube with a Nonuniform Delay System.—L. P. Lisovskiĭ. (*Radiotekhnika i Elektronika*, Sept. 1960, Vol. 5, No. 9, pp. 1442–1447.) An experimental investigation of a backward-wave tube with delay line in the form of a double comb, the teeth of which decrease uniformly in height along the axis of the tube. A variation of 2·25% in tooth height over one wavelength resulted in a ten-fold increase in restarting current required.

621.385.69: 621.372.2 **4368**

Feedback-Type Distributed-Amplifier Tube.—T. Kojima. (*Rev. elect. Commun. Lab., Japan*, March/April 1961, Vol. 9, Nos. 3/4, pp. 150–164.) The theory and design details are given for a tube in which the anode and grid form a double helix. Part of the amplified signal from the anode is fed back to the grid to compensate for line loss at high frequencies. The bandwidth of an experimental tube was 0–300 Mc/s. See also 3208 of September.

621.387: 621.362 **4369**

Optimization of Emission-Limited Thermionic Generators.—Schock. (See 4265.)

621.387.322: 621.316.722 **4370**

Comparison of Argon, Krypton and Xenon as Admixtures in Neon Glow-Discharge Reference Tubes.—F. A. Benson & G. P. Burdett. (*Proc. Instn elect. Engrs*, Part B, Sept. 1961, Vol. 108, No. 41, pp. 501–507. Discussion, pp. 507–510.) Certain desired tube characteristics can frequently be obtained by correct choice of gas mixture.

621.387.322.2 **4371**

The Stability of Reference Tubes using Monocrystalline Cathodes.—F. A. Benson & B. Rigg. (*Electronic Engng*, Aug. 1961, Vol. 33, No. 402, pp. 524–525.) The Mo crystal slices used are cut to expose the (1, 0, 0) face and the tubes are filled with Ne + 0·3% A at 45-mm-Hg pressure. Performance is superior to that of polycrystalline types.

MISCELLANEOUS

001.891: 621.396 **4372**

Radio Research 1960: The Report of the Radio Research Board and the Report of the Director of Radio Research. [Book Review]—Publishers: H.M. Stationery Office, London, 1961, 23pp., 2s. 6d. (*Nature, Lond.*, 23rd Sept. 1961, Vol. 191, No. 4795, pp. 1255–1256.)

ABSTRACTS AND REFERENCES INDEX

The Index to the Abstracts and References published throughout 1961 is in course of preparation and will be available early in 1962. A list of journals abstracted during the year, with publishers' addresses, will be included.